BIOMIMICRY in URBAN GREENING

Master's Thesis | Final Project

Sustainable Design Engineering Master's Programme

Aalborg University Copenhagen - 04, June 2021

titlepage

Education | **MSc in Engineering, Sustainable Design, 4th Semester**
University | **Aalborg University Copenhagen**
Project title | **Master's Thesis**
Project period | **02.02.2021 to 17.06.2021**

NOTE

PLEASE VIEW DOCUMENT WITH THE FOLLOWING PDF SETTINGS:

VIEW > PAGE DISPLAY > TWO PAGE VIEW
> SHOW COVER PAGE IN TWO PAGE VIEW

A4 pages | 134
Standard pages of text | 90
Characters (with spaces) | 215,076
Fonts | Gill Sans, Times New Roman

supervisors

Birgitte Hoffmann

Associate Professor, Department of Planning
Associate Professor, Faculty of Engineering for IT and Design
Center for Design, Innovation and Sustainable Transformation

Hanaa Dahy

Department of Planning, Associate Professor, PhD Dr.-Ing., M.Sc. Eng., Registered Architect

students

Lazaara Ilieva
Student No.: 20191420
BA in Mathematics at
New York University,
New York, USA

Lamiita Traista
Student No.: 20191425
BE in Information and Communication Technology
at VIA University College
Horsens, Denmark

Isabella Ursano
Student No.: 20191444
Bsc in Industrial Design at
La Sapienza University,
Rome, Italy

The individuals who have signed this page all agree with the content of this report.

abstract

This paper is a response to the urgent call for redesign of human-nature relations by addressing the need to move away from Modernist dualisms of nature-culture rooted in current unsustainable societies. Thereby, we adopt a procedural conceptualisation of sustainability, based in constructivist social theories, to open up the discussion from two points of departure: biomimicry and urban greening. We explore biomimicry as a possible novel relational approach to human-nature perspectives and interactions, which we seek to translate into urban greening strategies. We argue that urban greening must move towards process-oriented strategies that open up spaces for reflection on and new articulations of human perspectives and relations with nature, thus we take our vantage point in the interpretive flexibility of the biomimicry concept to inspire new possibilities in a local context. Based on initial methodological and conceptual considerations of biomimicry, we take the role of navigators and, through a compositionist design approach, we further develop our translation of biomimicry with sensitivity toward our urban greening context in Østerbro, a neighborhood in Copenhagen, Denmark. We then develop and stage a design experiment in order to make tangible our experimentation with biomimicry as a function for process-oriented urban greening strategies. Through the development and staging of our design experiment, we demonstrate how relations can be mobilised, both socially and materially, around the concept of biomimicry such that growing urban agendas can gain the transformational momentum needed to move toward more sustainable urban futures.

.

acknowledgments

We would like to express our deepest sense of gratitude to the supervisors of the project: Birgitte Hoffmann (Associate Professor at Planning for Urban Sustainability Center for Design, Innovation and Sustainable Transformation at Aalborg University [1]) and Hanaa Dahy (Associate Professor at the Department of Planning at Aalborg University, PhD Dr.-Ing., M.Sc. Eng., Registered Architect), for providing precious guidance, feedback and support throughout this Master's thesis project.

We would also like to extend our gratitude to our collaborators from Miljøpunkt Østerbro, Sara Jörn (Centerleader), Louise Purup Nøhr (Project leader), Lama Juma (Project leader), and from KulturØ, in particular, Emilie Bernt Haag (Culture and Project coordinator), as well as Signe Dragenberg, Park manager at Københavns Kommune, for supporting our research and sharing valuable practical insights for making our design experiment realisable.

We are also profusely thankful to Lars Pødenphant Kiær, co-founder of the Biomimicry Hub Denmark, for taking the time and effort to support us throughout the planning of the design experiment as well as his encouraging enthusiasm in participating in our project.

We would also like to thank Richard Haine, Director of FROG Environmental Ltd, who was very helpful and supportive, providing us with useful insights for our physical prototypes.

Lastly, we would like to thank our workshop participants Kasper, Nicola, Julio, Felipe, Sophia, Ilka, Allan, for their engagement, enthusiasm, and hardwork.

The project is 30 ECTS points, and all members of the group would like to be equally evaluated based on this report.

MILJØPUNKT ØSTERBRO

KØBENHAVNS KOMMUNE

BIOMIMICRY HUB DENMARK

[1] Associate Professor at the Department of Planning at Aalborg University, Associate Professor at the Faculty of Engineering for IT and Design at Aalborg University

[2] Registered architect, engineer and material developer at the research department BioMat (Bio-based Materials and Materials Cycles in Architecture), Junior Professor at ITKE (Institute for Building Structures and Structural Design) at the Faculty of Architecture and Urban Planning in the University of Stuttgart.

table of content

introduction

Responses of the design discipline to sustainability challenges have evolved considerably over the past few decades, in tandem with conceptual developments within sustainability discourse. Starting from a focus on isolated issues via incremental technological innovation, the design field has moved toward more systemic, discursive, and long-term understandings of and approaches to sustainability challenges (Gaziulusoy & Öztekin, 2018; Gaziulusoy, 2019). This shift is mirrored in the very notion of the Anthropocene that highlights the deepening entanglement of human and biosphere processes and the urgent call for a redesign of human-nature relations. Recent conceptualisations of sustainability, rooted in constructivist social theories, have turned designers' attention toward the examination and integration of different perspectives through discursive processes as well as the need to move away from Modernist dualisms of fact-value and nature-culture embedded in our current unsustainable societies (Robinson, 2004; Miller, 2013; Robinson & Cole, 2015; Maggs & Robinson, 2016; Escobar, 2017). Hence, in this thesis, we have adopted a procedural conceptualisation of and experimental approach to sustainability, in order to open up the discussion surrounding the potential role of biomimicry within sustainable design as a novel relational approach to human-nature perspectives and interactions.

In broad strokes, biomimicry is a novel science and design methodology characterised by an inspiratory flow of ideas and knowledge from the natural world to human systems (Speck et al., 2017), differentiated from other biologically inspired disciplines (See Appendixes 01 and 02) by its particular yet contested promise of sustainability (Benyus, 1997; Mead & Jeanrenaud, 2017; MacKinnon et al., 2020). More concretely, from 'bios', meaning life, and 'mimesis', to imitate, biomimicry is an interdisciplinary approach, bringing together biologists, designers, engineers, among others, to study and emulate nature's forms, processes and (eco)systems to solve human problems (Buck, 2017). However, in the literature, there are varying interpretations of how (and whether) biomimetic designs lead to sustainable outcomes (Wahl, 2006; Mathews, 2011; Mead & Jeanrenaud, 2017), how 'nature' is conceptualised within biomimetic practice, and to what extent 'mimesis' is a systematic emulation of nature or a discursive process of inspiration from nature (Fisch, 2017; MacKinnon et al., 2020; Blok & Gremmen, 2016). Thus, we have taken this interpretive flexibility of the biomimicry concept as a starting point for our discussions of its potential as a novel approach for cultivating more sustainable and synergistic human-nature relations.

Our focus on these relations is rooted not only in recent discussions within sustainability and design [3] discourse, but also in a growing 'urban greening' agenda that has been actively reframing nature as a central component of today's cities, implicating it in strategies of biodiversity enhancement, economic

[3] Including biomimicry literature, in which advocates of the design methodology frequently argue that biomimicry not only offers a paradigmatic shift in human production systems, but also an ontological shift that reframes sustainability in the context of humans being part of nature (Goldstein & Johnson, 2015; Mead & Jeanrenaud, 2017)

development, climate change adaptation and mitigation, social justice, human health and livability, among others (Karvonen, 2015; Cooke, 2020). These greening activities can be seen as the practical translation of the recent sustainability and design discussions, calling for a shift away from cultural perceptions of nature and cities as diametrically opposed domains (Soga and Gaston, 2016; Karvonen, 2015) and a paradigmatic shift toward more inclusive or 'compositionist' conceptions of nature (Latour, 2011) – a shift toward 'naturecultures' (Haraway, 2003). In Denmark, for example, government actors have been developing such urban greening strategies [4] with a more recent focus on civic engagement (Laage-Thomsen & Blok, 2020), such as the 'biodiversity pool' (biodiversitetspuljen) established by the Technical and Environmental Administration (Teknik- og Miljøforvaltningen) and Danish Society for Nature Conservation (Danmarks Naturfredningsforening) for funding citizen-driven biodiversity projects (Københavns Kommune, 2021). So, we take as our second starting point this growing urban greening agenda to contextualise and operationalise our experimentation with biomimicry.

In particular, we have collaborated with two organisations, Miljøpunkt Østerbro and Kultur Ø, based in Østerbro, Copenhagen, that have recently established a partnership in an effort to establish a 'green network' of green [5] associations, groups, and citizens to connect and collaborate on local sustainability projects (See Appendix 03). With Miljøpunkt Østerbro's focus on the environment ('miljø' meaning environment in Danish) and Kultur Ø's agenda on cultural activities ('kultur' meaning culture in Danish), their partnership can be seen as a reflection of the growing momentum toward 'naturecultures' and the cultivation synergistic human-nature relations. However, as Randrup et al. (2020) and Karvonen (2015) point out, such strategies are often unable to gain the transformational momentum needed to move beyond unsustainable human-nature relations, by continuing to instrumentalise human-nature interactions, "view[ing] nature through conventional lenses of recreation or ecological science" (Karvonen, 2015, p. 282).

We argue that in order to gain this transformational momentum, urban greening strategies must develop beyond outcome-driven initiatives, such as communal planting of wildflowers, toward process-oriented activities that open up spaces for reflection on and new articulations of human perspectives and relations with nature. And given the potential of biomimicry "to inspire new mindsets, values and narratives concerning the relationship between people and nature" (Mead & Jeanrenaud, 2017, p. 6), we have set out to mobilise the concept of biomimicry as a function for process-oriented urban greening activities. We hereby open the discussion for (a) biomimicry practitioners, (b) urban greening actors, and (c) sustainable design engineers by posing the question:

[4] e.g. CPH Urban Nature Strategy (Københavns Kommune, 2015), CPH Trees Policy (Københavns Kommune, 2018)
[5] 'Green' is often used equivocally to indicate a focus on environmental sustainability concerns.

How can biomimicry be translated into new urban greening strategies that challenge existing human-nature relations?

Our intention in posing this research question is not to present a definitive and absolute response, but rather to stimulate discussions among the three communities identified above, by: (a) developing our own conceptualisation of biomimicry as a sustainable design framework for urban greening; (b) staging a biomimetic design experiment as a process-oriented urban greening strategy; and (c) concluding with an in-depth reflection on the possible implications our thesis can have on the sustainable design engineering field.

As (b) suggests, an experimental design approach is adopted so as to make our translation of biomimicry, elaborated in (a), experientially available and bring to (analytical) light the navigational practices (Munthe-Kaas and Hoffmann, 2017) behind our embedding of the design experiment into our chosen context – a small park located in Outer Østerbro called Kildevældsparken. In this park, our collaborators have been developing plans for an art installation to serve as a material manifestation of the 'green network', from which greening activities can grow and mushroom throughout the neighbourhood (See Appendix 04).

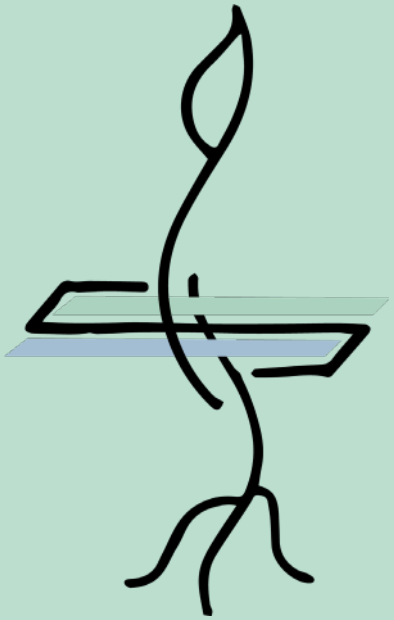
Given the tangible relations between humans and nature inherent to an urban park (often conceptualised in terms of recreation), we also mobilise the design experiment in our analysis not so much as a tool, but rather as "a part of the situation on which to reflect and construct knowledge from" (Johansen & Lindegaard, 2020, p. 202). Thus, we chose to stage Kildevældsparken as a common space, in which we drew together diverse actors, material objects (both in-situ and introduced), and meanings to enable and facilitate reflection, interaction, and co-creation centred around existing and future human-nature relations (Munthe-Kaas & Hoffmann, 2017).

In the following sections, we elaborate on the navigational and relational theories, briefly touched upon above, as well as the methods employed in our research and design. Then, we present a review of the biomimicry literature, based on which we develop our conceptualisation of biomimicry from a procedural understanding of sustainability and with sensitivity toward our urban greening context (in terms of both our collaborators' agendas and our chosen physical context). Subsequently, an analytical and reflective account of our design experiment is given, followed by a conclusion and discussion that touch upon the three perspectives introduced above and relevant areas for further research.

the three narratives

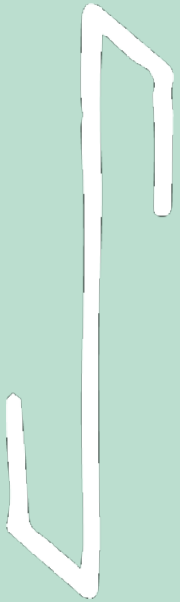
In order to tackle our research question and open the discussion for the relevant perspectives mentioned previously, this paper structures the research from the perspective of three narratives: biomimicry (BM), urban greening (UG) and sustainable design engineering (SDE). Thus, readers can guide themselves throughout this paper by the three logos illustrated below for each narrative, which will be added on the top right corner of relevant pages.

When the content is relevant for all three perspectives, the logo will combine all three elements as shown below.

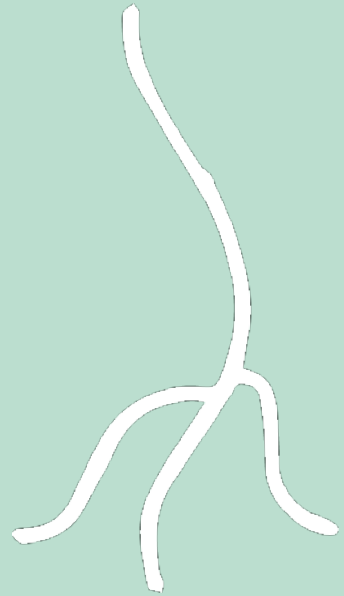


URBAN GREENING

BIOMIMICRY



SUSTAINABLE DESIGN ENGINEERING



theoretical framework

compositionist design

As we are working towards a shift in urban greening from a practice that is mostly outcome oriented to be more process oriented, we see co-design under the compositionist design programme (Binder et al., 2015) to be an appropriate lens to employ in our research.

In this programme, co-design becomes a process which can be considered a prototype in itself instead of a process aimed at making prototypes for mass production (Binder et al., 2015). This is an important aspect to consider in our research in order to avoid using biomimicry simply as a tool for innovating and designing new prototypes, but rather reflect on its conceptual and practical implications on a democratic design experiment framed as a prototyping activity that opens up discussions with the participants around human-nature relations in a transformative process for reframing urban greening.

In this project, we invited organisations and citizens to intervene in an urban park and re-imagine its future (Munthe-Kaas and Hoffmann, 2017). In this case, it's about re-imagining a setting - Kildeæveldsparken - understanding the problems and discussing possible solutions. More specifically, we are looking into the compositionist design, which stands in the 'design for and design with' sphere (See Appendix 05).

The way compositionist design proposes to approach this is through a 'meeting' between co-design and Actor-Network Theory (ANT). It is an effort of making a shift from the human centeredness in the participatory design tradition towards experimentation that includes both human and non-human participants and at the same time, to move away from radical inventions of the new toward reconfigurations of the existing (Binder et al., 2015).

actor-network theory and navigational processes

In this project, ANT is employed to illustrate a relational socio-material perspective on reality. The metaphor of a heterogeneous network is a central notion in ANT, which rejects the separation between human and non-human (Law, 1992). This notion is very valuable to the present research as it posits a world where humans never act alone, but rather inseparably from nature, while non-human things are rarely passive in their interactions with others (Lieto & Beauregard, 2013). As Law puts it simply, "[..] people are who they are because they are a patterned network of heterogeneous materials" (Law, 1992, p. 383).

By these means, our aim is to use ANT as an opening of seeing the world and use it to describe and navigate the democratic design experiment and its outcome. Since we want to position ourselves as temporary navigators of the green network and have biomimicry as a practical part of urban greening, we structure our narrative based on the three navigational processes proposed by Munthe-Kaas and Hoffmann's (2017):
(a) sensitivity - understanding the context and its socio-material dynamics,
(b) staging - intervening in the socio-material context for rehearsing possible futures,
(c) mobilisation - reimagining the socio-material context, where actors are brought together in a new performance of the city.

These practices can be interpreted from Latour's (1998) perspective as 'machinations' that support the urban greening initiator, as a central actor within the network, to put together new socio-technical networks.

In this project we, as designers, are taking on the role of navigators first, with the aim to have urban greening actors transition into this role at the later stage and develop their practices. This is due to biomimicry being a novel approach that we would like to first explore and navigate ourselves in the context and experiment with its promises for closing the gap between culture and nature.

Within the three navigational processes outlined, the focus is on describing relationships among human and non-human actors and how they change based on the effect that actors have within the network. This means that actors are not the source of an action, but all action is instead relational and distributed within the network because actors are constantly engaged by others to form and break networks (Latour, 2005). A way for actors to be engaged by other actors in the network is through interessement devices - a concept developed by Callon (1986). In this paper, we employ interessment devices as a conceptual tool to discuss our interventions in and reconfigurations of networks (Latour & Woolgar, 1986). We hence draw on Hansen and Clausen (2017),

defining interessement devices as "[..] non-human elements which are circulated by key actors in order to inspire other actors to support change" (Hansen and Clausen, 2017, p. 346). Hence, biomimicry and the various means of shifting relations between urban greening networks are regarded in this paper as interessment devices. These relations between actors are made through a process known in ANT terminology as 'translation'. "Urban greening is ultimately about building relations, both socially and materially" (Karvonen, 2015, p. 282), and thus, as our research question suggests, we will seek to translate biomimicry in urban greening strategies for building new relations in the network.

In the sensitivity analysis, we highlight and discuss existing relations in the context. The aim however is not to work systematically in mapping everything that makes up the context, but rather exercise the ability to learn "[..] about the values, meanings, emotions, relationships and power with a focus on opening the project up to new perspectives and futures" (Munthe-Kaas and Hoffmann, 2017, p. 292).

As part of staging, we employ Latour's (2008) concept of 'drawing things together'. Latour (2008) highlights that the more 'matters of fact' are turned into 'matters of concern', it implies that in design, more objects are being turned into things. 'Things' in this context are perceived as artefacts which are made up of "[..] assemblies of contradictory issues" (Latour, 2008, p. 4), as there can be various interpretations of what a design stands for. Or simply put in a previous publication, the 'thing' is "[..] the issue that brings people together because it divides them" (Latour and Weibel, 2005, p. 23).

We 'draw things together' by staging a design experiment, in the form of a workshop, by which citizens are invited to explore applications of biomimicry for urban greening in their local context. In particular, we seek to explore how urban nature (in this case, the non-human life in Kildevældsparken), which is often considered by citizens to be a 'matter of fact', a setting for human activities, can be brought forward as a matter of concern through the use of biomimicry. Approaching urban nature as a matter of concern enables us to work with common world-building in the given context, in contrast with phrasing it as a matter of fact which is, by definition, unable to change and able to be forced in any context (Latour, 2005). This enables the exploration of new articulations of human-nature relations, by opening up spaces for reflections on human perspectives and relations with nature.

The design experiment thus becomes a continuous opening of the field where it is not necessarily focused on making a prototype (Binder et al., 2015). In our research, the prototyping activity, part of the design experiment, has the purpose of experimenting with biomimetic interventions for urban greening and as a means for participants to be given the freedom to own and co-create them together.

Mobilization is the process of aligning actors in new ways and the network being mobilized can be considered the outcome of the project. This third process is not done in a sequential manner, but is rather an ongoing process throughout the whole project, which aims at binding more actors and narratives together, "[..] based on sensitivity for what is and staging of what can become." (Munthe-Kaas and Hoffmann, 2017, p. 293).

Seeing ourselves as navigators in this research is beneficial for us to answer our research question as it allows our role as Sustainable Design Engineers and our reconceptualization of biomimicry to be transformed through the experiment. In this way, our analysis can offer insights into the implications of not only biomimetic processes on existing urban greening agendas, but also of staging design experiments on building relations. The navigator takes a central role in the network which can develop in multiple ways depending on its abilities and position in the network (Munthe-Kaas and Hoffmann, 2017). In this process we reflect on the degree of machination needed for mobilizing actors in the network, based on the purpose of the design experiment, which is about reimagining and rehearsing future possibilities (ibid.).

methods

affinity diagram

The affinity diagram is a method for thematic analysis of a large number of ideas, by organising them based on their natural relationships (Tague, 2009). Most often, this method is employed by design teams to structure their brainstorm ideas, but in this research it was used to organise many facts and ideas found in literature about biomimicry, in order to be able to better grasp the complex and plural issues, promises and implications inherent to biomimicry as a concept. This was done by extracting relevant quotes and topics about biomimicry from a large collection of research papers in a document, after which we organised them based on their affinity into different themes. Instead of conducting this process with physical materials such as sticky notes, pens and a large working surface as described by Tague (2009), we adapted and used similar materials in digital format by making use of miro, a digital platform for collaboration (see figure 01).

Following the procedure from Tague (2009), our first step was to record each quote or idea extracted from the literature on a separate sticky note and place it on the board randomly. We then searched in the pile of sticky notes for "[..] ideas that seem to be related in some way" (Tague, 2009, p. 96). Normally, design teams are strongly advised to not talk during this step (ibid.), but since our application of the affinity diagram was not for organising our own ideas from a group brainstorm, but various standpoints from other researchers, we took the liberty of discussing the content with each other. This exercise was repeated until all the sticky notes were divided into groups and then groups were combined into main themes where applicable. The end result brought clarity and consensus between different lines of thought and disciplines employing biomimicry in their work, which gave us an informed and detailed foundation on which we have reviewed the literature and defined our own understanding of the concept to be used in the present research.

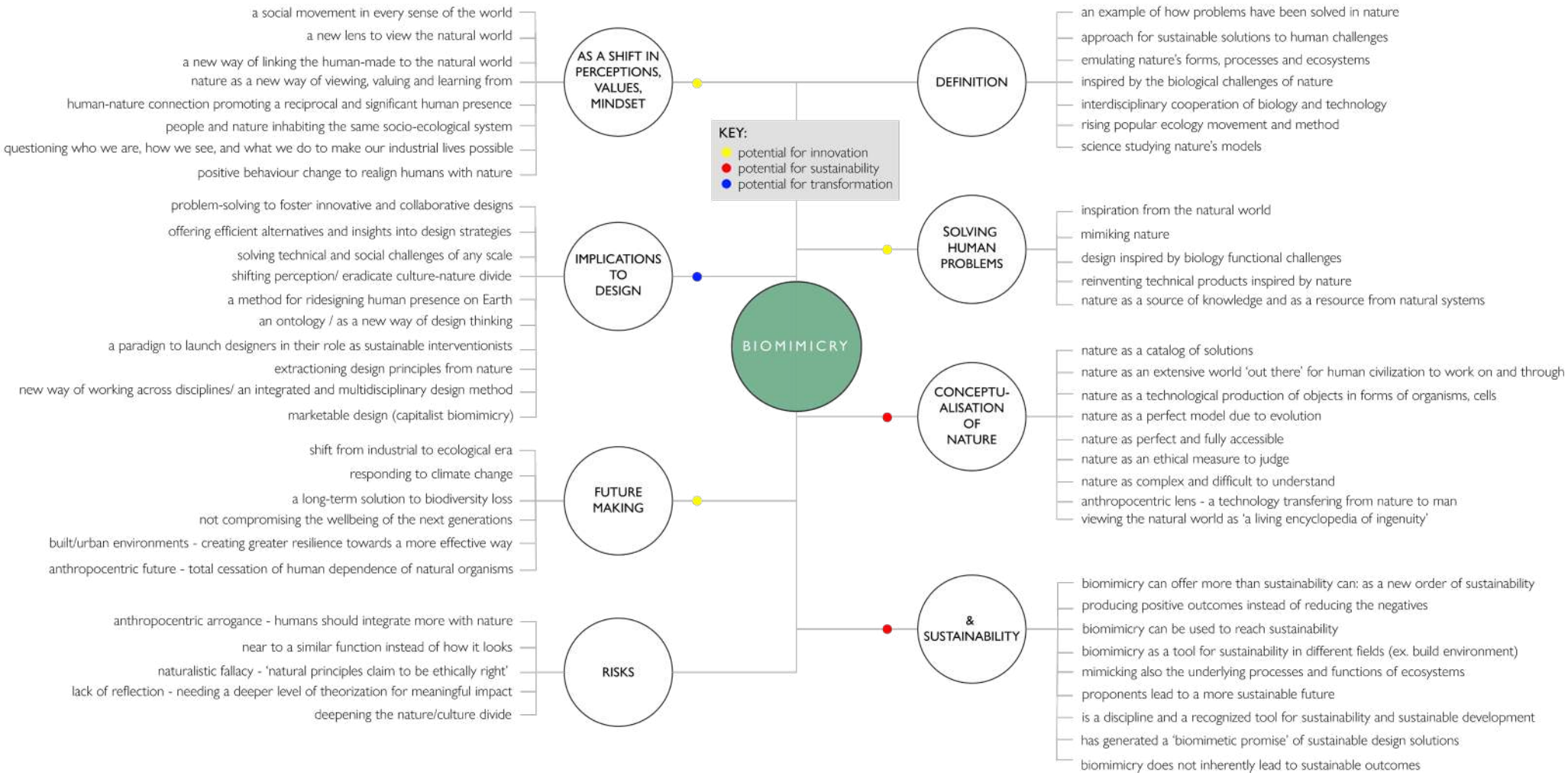


Figure 01: Synthesized version of the Affinity Diagram (for references and detailed version, see Appendix 06).

semi-structured interviews

Given our experimental and highly situated approach to working with biomimicry, our research required methods with a heightened sensitivity toward our context. Thus, qualitative research methods proved to be central for our research as it allowed us to gather empirical insights and highlight existing relations in the local context. In particular, semi-structured interviews were employed as "[..] a verbal interchange where one person, the interviewer, attempts to elicit information from another person by asking questions. Although the interviewer prepares a list of predetermined questions, semi-structured interviews unfold in a conversational manner offering participants the chance to explore issues they feel are important" (Longhurst, 2003, p. 143).

Particularly during our sensitivity analysis, this method enabled us to be open to what people want to share, as well as listen and learn about the relevant network dynamics and complexities. Throughout this research, semi-structured interviews formed the basis of the dialogues we held with our collaborators, as well as our communication with other actors in the network. They were important in revealing varying, and at times, contradicting perspectives, values, challenges and standpoints in the network, but also gave the interviewees the freedom to express themselves freely and feel that there is a collaborative space central to the development of the project.

design games

In an effort to more actively facilitate and coordinate this co-productive approach in our design research, we were inspired by design games. In particular, while staging the design experiment, as discussed in the theoretical framework, we employed design games as a method to create some of the workshop activities which aimed to take participants into nature's realm as part of the biomimetic process. As outlined by Brandt et al. (2008), design games are able to take participants into 'as-if-worlds' as a means "[..] to engage the players on equal terms, allowing their personal concepts to come forward" (Brandt et al., 2008, p. 58). Thus, this method enabled us to also reveal existing human-nature relations in the local context as the participants became immersed in the game. In addition, our choice of staging the experiment on-site contributed significantly to the immersive quality of as-if worlds, such that the setting became an element of the game, transitioning the participants from the daily practices to a 'magical' setting (Vaajakallio and Mattelmäki, 2014).

Inspired from the design game features described by Brandt et al. (2008), the conceptualisation of the activity followed a simple set of criteria: a) rules of the collaborative activity should be simple and explicit; b) there should be pre-defined gaming materials available; c) the game should place the players in a setting different than the everyday context, and d) the game should explore and establish new configurations of the game materials (ibid.). However, since our employment of design games was an integrated element of a broader design experiment, the level of complexity and detail of the materials was minimised. In this way, we were able to interlace our experiment with games that immersed participants in a collaborative space, without deviating too far from the other, more instructive, aspects of the experiment.

prototyping

As discussed previously, the present research employs prototyping as both a process and an outcome in the design experiment. Prototyping as a process is central to this research, as it is an important aspect brought forward by the compositionist design programme that we employ. Hence, the design experiment serves as a prototype for how biomimicry could be translated in urban greening strategies. Since this is not a physical mock-up, we elaborate on how it was developed and staged in more detail in the following chapters. Instead, here we would like to highlight the role of prototyping as an outcome in the workshop. Inspired by Brandt (2007), we used prototypes as 'things-to-think with', so that we, as designers, gave participants at the workshop a tangible, yet loose idea of the biomimetic innovation proposed. In this way, the prototype served as a material embodiment of the co-creative space we were offering the participants, giving them the opportunity to rethink the design and build new prototypes. Here, the level of detail for the initial mock-up was a key consideration, since the more details present in a mock-up, the more "[..] the design process seems to converge to the final design" (Brandt, 2007, p. 191). One of our aims for the design experiment was to make the exploration of synergistic human-nature relations a tangible activity, such that participants not only reflected on their relations to nature on a deeper level, but also came together to design and craft a physical intervention that embodied these reflections and the potential for collective change. For this reason, we created an initial high-fidelity prototype to focus participant efforts in creating and finalising an outcome that worked within the limited time scope of a single-day workshop. However, our choice of materials (repurposed garden waste) gave the prototype an unpretentious and accessible quality that left space for 'thinking with things' and co-productive creativity. Thus, embedded within a larger process, the physical prototypes served as biomimetic empowerment devices for urban greening.

biomimicry | methodological and conceptual considerations

In this section, we present a review of the biomimicry literature, developing upon methodological and conceptual considerations, in an effort to contribute to the growing calls in the literature for more reflective discussions. We then propose a framework, which synthesises recent reflective deliberations in the literature, as a possible direction for further theorisation of biomimicry, aiming to elaborate on the potential of biomimicry to "help launch designers into their new role as sustainability interventionists." (Kennedy et al., 2015, p. 66) and to ultimately cultivate more sustainable human-nature relations.

methodological considerations

This section presents an overview of biomimicry as a design practice, informing our point of departure in employing biomimicry in our research.

Biomimicry as a design practice is widely known as a 'meeting' between biology and technology or other fields of innovation (Uchiyama, 2020; Speck et al., 2017; ISO 18458, 2015; Hanaa - See Appendix 07). Janine Benyus, author and Biomimicry 3.8 consultancy co-founder, is known as the one who popularised biomimicry in the context of design for sustainability (Ceschin & Gaziulusoy, 2019). She differentiates between three levels of mimicking nature: form, process and ecosystem (Benyus, n.d). These can be interpreted based on their degree of sophistication, where mimicking form is considered to be the most shallow or reductionist approach to biomimicry and mimicking ecosystems the most deep or complex approach to biomimicry (Ceschin & Gaziulusoy, 2019). Box 1 below provides an overview of the mimicking levels, offering illustrative examples (for further details see Appendix 08).

The natural phenomena being mimicked is often referred to as a biological model or biological system that can range from a part of an organism, to an organism or any other living system (Cohen & Reich, 2016). In the examples showcased in Box 1, bio-

Box 1

Biomimetic design examples for levels of mimicking nature

Japan's Shinkansen Bullet Train

Japan's Shinkansen bullet train was considered to be too loud as it was coming out of tunnels, so the front end of the train was redesigned to mimic the shape of the kingfisher bird's beak. Kingfishers are able to move through air and water fast and with minimum impact / noise as they have long and narrow beaks. (Ceschin & Gaziulusoy, 2019; Biomimicry Institute, n.d.-a).

Innovator: ***JR-West***
Biological Model: ***The beak of a Kingfisher bird***
Mimicking level: ***Form (leading to implicit function)***
Design process: ***Problem driven***

Velcro®

Velcro® is the most common example of biomimicry, applied in a wide variety of products such as shoe straps, jackets or laptop bags (Manual, 2013). This has been inspired from the way a seed from Burdock plant attaches temporarily to an animal's fur to travel long distances before germinating (Biomimicry Institute, n.d.-b).

Innovator: ***George de Mestral***
Biological Model: ***Seed of the Burdock plant***
Mimicking level: ***Form (leading to implicit function)***
Design process: ***Solution driven***

Flectofin®

Flectofin® are moving façades inspired by the mechanics of a very light thing that can open with very little energy, just like the Strelitzia reginae flower (known as the Bird of Paradise) that opens after a bird sits on it (López et al., 2017). The biomimetic process involved a deep understanding of the plant's mechanical performance.

Innovator: ***University of Stuttgart's Institute of Building Structures and Structural Design***
Biological Model: ***Valvular pollination mechanism in the Strelitzia reginae flower (Bird of Paradise)***
Mimicking level: ***Process***
Design process: ***Problem driven***

BioHaven® Floating Island

BioHaven® Floating Island is emulating wetland ecosystems for improving water quality (by capturing, absorbing or filtering organisms, chemical entities, etc.), cycling nutrients as well as enhancing biodiversity. These biological and physical processes interact with many other factors, such as temperature and land structure, that affect a wetland's overall function (Biomimicry Institute, n.d.-c).

Innovator: ***Floating Island International***
Biological Model: ***Wetland ecosystems***
Mimicking level: ***Ecosystem***
Design process: ***Problem driven***

logical models range from a part of an organism or an organism (i.e. the beak of Kingfisher bird, seed of the Burdock plant), the behaviour of an organism (i.e. valvular pollination in the Strelitzia reginae flower) or a whole ecosystem (i.e. wetlands).
Furthermore, when employing biomimicry as a design practice, there are two directions that can be adopted, based on whether the design team chooses to first look for an inspiring biological system in nature and then emulate it in different designs or the design team chooses to define a particular problem first and then look in nature for possible solutions. Based on the review of the terminologies used for the two biomimetic design directions in literature done by Cohen & Reich (2016), we choose to employ the terms solution driven and problem driven introduced by Helms et al. (2009). This is to abstract any terms referring to specific disciplines (e.g. biology to design, technology pull etc.), since there could be a wide variety of backgrounds involved in the process, or terms which could imply a hierarchical distinction between the natural world and humans (such as 'top down' and 'bottom up').

From the biomimetic designs exemplified in Box 1, most of them employ a problem driven approach, while Velcro® is the only one that employed a solution driven approach, as the inventor first got inspired by the Burdock plant's seeds and then seeked to find useful applications to human needs. The generalised steps for employing biomimicry (Ceschin & Gaziulusoy, 2019) as both solution driven and problem driven approaches can be seen in figure 02.

Although the process is visualised as strictly linear, in real-world applications, the process is more iterative as steps require evaluation and reflection (ibid.). This is because understandings of the problem and the biological systems keep influencing and reshaping each other along the way, so the output from later stages often influence previous stages, leading to many feedback and refinement loops (Helms et al., 2009).

However, for the purpose of the present research, the linear illustration of the process proves to be sufficient as a point of departure. Since our aim is to translate biomimicry into urban greening activities, a thorough overview of the concept is needed in order to avoid using biomimicry simply as a tool for innovating and designing new prototypes, but rather reflect on its conceptual and practical implications as a sustainable design methodology. Furthermore, we use the generalized steps as a foundation in our endeavour to translate biomimicry in urban greening, upon which we can explore the iterative nature of the process ourselves and adapt it based on the local context, without posing any initial constraints.

In this paper, we focus on a problem driven approach to biomimicry in particular, as we argue that this approach has higher

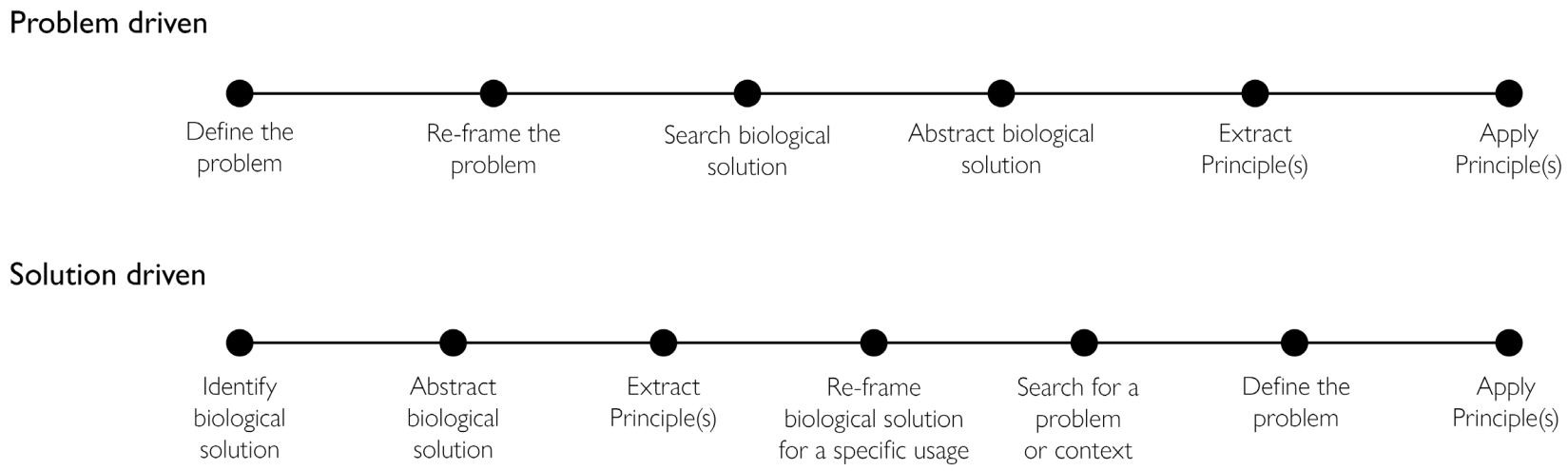


Figure 02: Generalised steps of problem-driven and solution-driven biomimicry processes.

chances to lead to sustainable outcomes. Furthermore, this approach supports Aalborg University's model of Problem Based Learning (PBL) (Aalborg University, n.d.). However, in the literature, there is a clear dissensus regarding biomimicry's sustainability promise. Thus, the following sections assess biomimicry based on its sustainability promises and classifications discussed in the literature, which inform our own conceptualisation of biomimicry that seeks to respond to sustainability challenges, having a focus on reflexivity and existing problematic relations between humans and nature, which could be employed in the context of urban greening strategies.

conceptual considerations

The systematic disciplinary interaction between biology and technology has been receiving increasing attention over the past few decades across many fields including architecture, urban design, product design, computer science, medicine, and materials science among others (MacKinnon et al., 2020; Speck et al., 2017). Within this approach to innovation, characterised by an "inspiratory flow of ideas from nature to technical solutions" (Speck et al., 2017, p. 1), biomimicry is a distinct discipline, differentiated from other biologically inspired disciplines (See Appendixes 01 and 02) by its particular focus on and promise of sustainability (Benyus, 1997; MacKinnon et al., 2020). It is framed as a response to the growing calls for alternatives [6] to the ecologically destructive technologies, systems, and approaches of the current industrial age defining current unsustainable human-nature relations (Blok & Gremmen, 2016). In the literature, biomimicry is frequently characterised by its promise to achieve sustainable designs (Wahl, 2006; Kennedy et al., 2015; see Appendix 09 for designs within urban context), to reconnect humans with nature (Buck, 2017; MacKinnon et al., 2020; Mathews, 2011), to regenerate ecosystems (Pedersen Zari, 2015), and to fundamentally transform the way we think by "dismantl[ing] anthropocentric narratives of production and stories of human domination over nonhuman life" (Goldstein & Johnson, 2015, p. 67; Mead & Jeanrenaud, 2017; Reed, 2004).

The fundamental principle driving these biomimetic promises centre around the emulation of nature's time-tested patterns – 3.8 billion years of evolutionary optimisation. The argument builds on the fact that life on Earth has been developing for 3.8 billion years, while humans have been around for a mere 200,000 years – a blink of an evolutionary eye. Thus, nature is often conceptualised as "a catalogue of products" (MacKinnon et al, 2020, p. 6), "a living encyclopaedia of ingenuity" (Buck, 2017, p. 122), "a large database of strategies and mechanisms" (López et al., 2017, p. 693), or "a gigantic pool of ideas" (ISO 18458, 2015) that has 3.8 billion years' worth of insights and clever adaptations to offer – an untapped wisdom that humans should consult, emulate, and learn from to 'achieve' sustainability (MacKinnon et al., 2020; Uchiyama, 2020). In other words, the natural world has characteristics that, if systematically studied and transferred, can help us move toward sustainability. However, this characteristic promise of sustainability is frequently contested in the literature, since biomimetic designs do not always lead to more sustainable outcomes (Kennedy et al., 2015; Pedersen Zari, 2018; MacKinnon et. al., 2020; Helmrich et al., 2020), as well as the very notion of sustainability being itself a contested concept (Connelley, 2007).

[6] McDonough and Braungart's Cradle to Cradle design approach reflects a similar orientation, maintaining that "the laws of nature are the bedrock of good design" (2002a, p. 1).

> "As a field, biomimicry is diverse and, at times, less than coherent. Its practitioners can scarcely agree on the term's definition, on what level of fidelity to nonhuman life is required for a project to count as 'biomimesis' or to what ends its methods are best applied." (Goldstein & Johnson, 2015, p. 64)

> "Further critiques of biomimetics have noted that the application to sustainability challenges requires deeper levels of theorisation to have meaningful impact. The emerging literature on biomimetics, however, tends to be focused on the technical translation of biological function without explicit consideration for the state-of-the-art thinking regarding sustainability considerations." (Mead & Jeanrenaud, 2017, p. 2)

We will hence provide an overview of these debates in the literature, bringing to light the various classifications of biomimicry, the fundamental assumptions underlying the conceptualisations of sustainability, nature, and mimesis in these discussions, as well as our initial work on a framework that synthesises these considerations in an effort to elaborate on the potential of biomimicry to cultivate synergistic approaches to sustainability challenges.

'biomimicry for x' classification

In the literature, various classifications of biomimetic designs have been developed. Some are particularly technical, differentiating between 'classes' of bio-derived developments, such as Speck et al.'s decision tree classification tool (2017). This level of detail is beyond the scope of the present review as it does not offer a relevant point of departure for our discussion regarding biomimicry as a sustainable design methodology and human-nature relations. The classifications that will be discussed here are more broadly based on motivations for applying biomimetic approaches to the design process, i.e., a classification of biomimicry's (design) promises (Pedersen Zari, 2018; Uchiyama et al., 2020; MacKinnon et al., 2020). Common to many of these classifications is the distinction between what is called 'biomimicry for innovation' and 'biomimicry for sustainability' (ibid.). Box 2 below provides an overview of both classes, offering a general description of each category derived from the literature along with examples.

Within these articulations of biomimetic promises, sustainability is often treated as an achievable steady state for which biomimicry becomes a 'tool' or 'vehicle'. In practice, designers translate this steady state in terms of harm reduction and damage limitation approaches with an explicit focus on discrete, easily quantifiable performance outcomes. For example, in the context of the built environment, biomimetic designs have led to reductions in embodied energy of construction materials, improvements in energy and structural efficiency as well as in material use and maintenance (Buck, 2017; López et al., 2017; Hanaa - See Appendix 08). Such translations of the concept of sustainability are deeply rooted in 'traditional' articulations of sustainable development (e.g. net zero, harm reduction, damage limitation, eco-efficiency [7]) that assume an inherently harmful characterisation of human activity that must be minimised.

More recently, however, such traditional framings of sustainability employed in biomimicry discussions have been broadened to encompass new articulations of how to be in the world that are based an understanding of humans being a part of nature, rather than apart, echoing ongoing discussions of bio-inclusive ethics (Mathews, 2011), conceptions of value (Callicot, 1984; O'Neill, 1992; O'Neill & Spash, 2000), and net-positive outcomes (du Plessis, 2012; Robinson & Cole, 2015). Pedersen Zari, for example, proposes a third category, 'biomimicry for human psychological well-being', which is rooted in the motivation to explore "whether design based on an understanding of the living world could contribute to increasing human psychological wellbeing" (2018, p. 18). Since her focus is based in architecture and urban design disciplines, her discussions of this third category centre

[7] See McDonough and Braungart (2002b) for an in-depth discussion of the notion of 'eco-efficiency' and "why being 'less bad' is no good" (p. 45).

Box 2

Biomimicry for innovation vs. Biomimicry for sustainability

Biomimicry for innovation	Biomimicry for sustainability
The study and application of nature's evolutionarily optimised strategies through the highly interdisciplinary work characteristic of the biomimetic design process, bringing together experts from the fields of biology, engineering sciences, design, among others, possesses a particularly high potential for innovation and offers practitioners a new way of looking at products, systems, organisations, without a driving concern for ecological performance (ISO 18458, 2015; Pedersen Zari, 2018; MacKinnon et al., 2020;).	The study and application of nature's strategies through interdisciplinary work is motivated by an explicit concern to create designs that are well-adapted and integrated into life on Earth by considering product life cycles and earth system limitations (Pedersen Zari 2018; Kennedy et al., 2015).
Example: Velcro® (see Box 1)	*Example: Flectofin® (see Box 1)*

around biophilic design, which combines research and frameworks of human psychological connection with the perceivable natural world (see Ives et al., 2018; Soga & Gaston, 2016) with spatial design and urban planning concepts (Pedersen Zari, 2018, p. 18).

MacKinnon, Oomen & Pedersen Zari (2020) further develop on this, proposing the classifications, 'biomimicry for transformation' and 'biomimicry for society'. In particular, they argue for the potential biomimicry has to present new narratives of sustainable human participation in nature and the realignment of human systems within biological systems. Although MacKinnon, Oomen & Pedersen Zari (2020) do not differentiate between the two categories nor offer concrete translations of either in practice (i.e. what it means for the designer to pursue this 'class' of biomimicry), they do highlight a need for more reflective, than solely active, biomimetic practice in order to further develop the concept of biomimicry in an effort to realise its ambitious potential "to inspire new mindsets, values and narratives concerning the relationship between people and nature" (Mead & Jeanrenaud, 2017, p. 6). In the following section, we give a brief overview of the responses in the literature for these deeper levels of theorisation of the biomimicry concept.

'weak vs. strong biomimicry' classification

There has been a growing number of responses that pursue this reflective approach. Here, biomimicry is often discussed in terms of its conceptualisation of nature, mimesis, technology and ethics, thereby developing yet another, more ontological classification of biomimicry that distinguishes between 'strong' and 'weak' biomimicry (See Appendix 10), reflecting interpretive flexibility of the biomimicry concept.

As briefly touched upon above, within biomimetic practice, nature is often treated as a catalogue or database of products, ideas, and ingenuity for humans to categorise, disassemble and adapt to human systems. This conceptualisation of nature is characteristic of strong biomimicry, which assumes a perfect and perfectly knowable nature as well as human epistemic sufficiency to 'know' nature, so that nature's 'wisdom' may be reproduced in biomimetic designs (Blok & Gremmen, 2016). Consequently, the strong conception of mimesis hinges on the imitation of this perfect nature, by which elements of the natural world are "dissected, pulled apart and reconstituted as an assemblage of capacities" (Goldstein & Johnson, 2015, p. 73) to be studied, translated, and applied to human systems. In this way, nature remains conceptualised as the first nature of Enlightenment thought – as a universal world 'out there' for human civilisation to work on and through (ibid.) – an entity necessarily separate from the human realm.[8]

The weak conception of biomimicry, on the other hand, hinges on a less perfect nature, upon which humans may build via a flexible understanding of mimesis that beckons "a sense of co-becoming, co-individuation of form and matter" (Fisch, 2017, p. 806). In other words, weak mimesis more closely resembles inspiration rather than imitation, such that designers become drawn into a dynamic dialogue with material nature and "acknowledge that human beings are merely participants in rather than masters over a complex ontological entanglement from which emerges a shared design for (human and nonhuman) lived

[8] Advocates of biomimicry often argue that biomimicry is a vehicle for a shift away from the dominant extractivist human-nature relationship characteristic of the industrial age, toward a more sustainable ecological age, in which the human presence on Earth is fundamentally (re)configured based on the ontological principle that humans and nature inhabit the same socio-ecological system (Buck, 2017; Pawlyn, 2019; Goldstein & Johnson, 2015). However, the term 'extraction' is widely used in biomimicry literature, not in terms of the extraction of physical resources, but rather the extraction of intellectual resources or principles from nature (Speck et al., 2017; López et al., 2017). The discourse surrounding biomimicry thus changes the dominant industrial narrative, but only slightly. For humans to extract something from nature (whether it be a physical resource or a design principle), a separation between human and nature is a necessary logical presupposition. So, we see that through the language used by biomimicry advocates and biomimics, the transformational potential of biomimicry is curbed by its perpetuation of the ontological separation between nature and culture. Although the role of languages and narratives is a topic beyond the scope of this research, it is an interesting topic for future research for biomimicry as well as other methodologies, fields, concepts, and frameworks operationalised for greater sustainability transitions.

reality" (ibid, p. 807). In this way, nature is treated as "an ecology of material iterations with which to think" and biomimicry becomes a process that "animates all toward a new arrangement of becoming" (ibid., 818).

So, by taking a more flexible conceptualisation of mimicry, the designer's focus shifts from performance outcomes to process outcomes. This allows the designer to enter into a more discursive and synergistic relationship with nature, where "nature is no longer a viable and stable category of thought" (Goldstein & Johnson, 2015). In this way, the design of experimental and communicative processes become an important element in developing what Freya Mathews calls 'a new culture of engagement with nature' by which we "allow nature to 'redesign' not only our commodities but also our own desires" (2011, p. 19). This 'weak' conceptualisation of biomimicry thus pursues a more procedural understanding of sustainability that moves beyond the harm reduction discourse and shines a more positive light to human activity, calling for explorations of net-positive outcomes for both humans and non-human nature (Robinson & Cole, 2015) and "conscious processes of learning and participation through action, reflection and dialogue" (Reed, 2007, p. 678).

Although the 'strong vs. weak' discourse on biomimicry paints a relatively black and white classification of biomimicry, the debates are nuanced, indicating yet another layer of flexibility to the concept and its application. This nuanced view of biomimicry, however, is often overlooked and simplified in sustainable design literature. Take for example Ceschin & Gaziulusoy (2019), whose Design for Sustainability (DfS) framework, depicted below (figure 03), limits the scope of biomimetic design interventions primarily to material, component, and product levels centred around user-product interactions. We see a clear underestimation of the potential of biomimicry to affect change on greater levels of socio-technical-ecological systems and human-nature interactions. Thus, we take the authors' DfS framework as a point of departure for the development of our own framework that aims to open up biomimicry as a design for sustainability methodology.

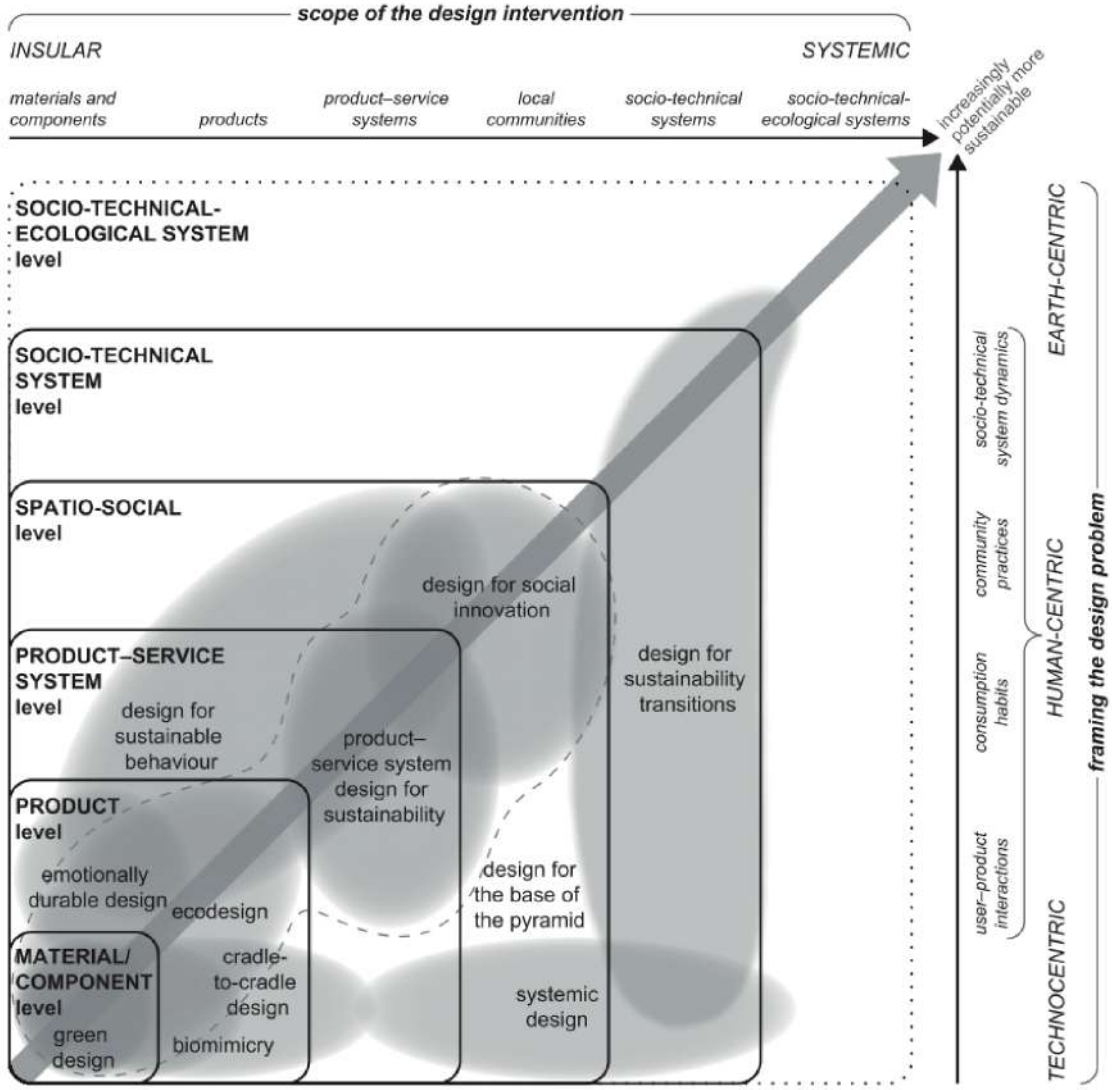


Figure 03: Ceschin & Gaziulusoy (2019) Design for Sustainability framework.

biomimicry for sustainability framework

In an effort to respond to this depreciation of biomimicry and highlight its broader role as a sustainable design methodology, we have attempted to frame our discussions above in terms of the 'biomimicry for X' classification and the nuanced conceptualisation of mimicry. It is important to point out that the following discussion aims to present a possible direction for further development in constructing a more holistic and reflective theorisation of biomimicry and its application to sustainability challenges. It is equally important to highlight that the mapping of biomimetic designs within our framework is qualitative, thus it is subject to a certain degree of interpretation.

Similar to the vertical spectrum of Ceschin & Gaziulusoy's (2019) DfS framework, we position the 'biomimicry for X' classifications on our first dimension (x-axis) (figure 04 below - for an in-depth discussion of the examples included in the diagram and their respective positions within the framework, refer to Appendix 11). This dimension represents the scope of the biomimetic promise, which can also be understood in Pedersen Zari's terms of "the projected end aspirations of different kinds of biomimicry [in an effort] to avoid the assumption that just because an object, material, system or building mimics nature in some way, it is inherently more sustainable" (2018, p. 17). So, as we move further away

Figure 04: First dimension of our framework. The varying placement of the examples in the vertical direction is for visual purposes only.

from the origin, to the right, the projected scope of the biomimetic intervention becomes more and more concerned with responding holistically to sustainability challenges.

We begin with 'biomimicry for innovation' on the far left side, which encompasses biomimetic research and designs that "are about novel approaches to technical problems, increased performance capabilities, or the ability to increase economic profit margins'' (ibid., p. 17). This is a clear techno-centric aim whose projected end aspirations revolve around user-product interactions and commercial interests [9], like the Velcro example illustrated in Box 2. Following is 'biomimicry for harm reduction', in which, as discussed earlier, sustainability is understood in terms of the net-zero approach that does not necessarily counteract unsustainable trajectories, but rather slows them down. Thus, the example placed in this section is illustrative of a biomimetic design that has aimed for quantifiable performance outcomes such as reduced energy and material use. Next, we move toward a more transformational conception of sustainability, based on which biomimicry is used to affect paradigmatic changes on a societal scale. Here, we coalesce 'biomimicry for human psychological well being', 'biomimicry for transformation', and 'biomimicry for society' under a more general classification that we call 'biomimicry for societal transformation', since all three present a particular focus on the re-evaluation of human presence on Earth by defining a new social order within planetary boundaries (Pedersen Zari, 2018; MacKinnon et al, 2020).

Within this category, the notion of biosphere limits and planetary boundaries functions as a fundamental principle driving responses to sustainability challenges. Research and design agendas thus centre around a knowledge-first approach, by which "science characterises problems in terms of their causes and mechanisms and forms a basis for subsequent action" (Miller, 2013). In this way, design work is geared toward a net-zero approach – a redesign of our means without consideration of our ends. In line with Robinson & Cole (2015) and Mathews (2011; 2019), we argue that a shift beyond this constraints and limits discourse is needed to engage in 'a co-creative partnership with nature' by designing processes of reflection, feedback and dialogue and thereby exploring possibilities of net-positive outcomes and synergistic human-nature relations. Borrowing Mathews' notion of a 'form of synergy proper to biomimicry', we propose a fourth classification – 'biomimicry for biosynergy'.

> "Synergy represents a new horizon in biomimicry thinking because in the transition to synergy we are moving from a mutualism of means, as proposed by theorists such as McDonough, to a rapprochement of ends: Instead of thinking merely about how to devise technological means for achieving our current consumer ends consistently with the

[9] For a more in-depth discussion of biomimicry as an avenue of innovation and economic production, by which nature remains entangled with logics of capital accumulation and resource privatisation, see Goldstein & Johnson (2015).

> interests of nature, we start thinking about our ends themselves. What should we want? What does the rest of nature want us to want? To practise biomimicry in the deepest sense is, first and foremost, I would venture to suggest, to fathom this… Biosynergy would [thus] involve arranging for existing life systems to serve our ends but only to the extent that their doing so was compatible with their also continuing to unfold toward ends of theirs." (Mathews, 2011, p. 14-15).

Her notion of biosynergy thus takes us a step beyond procedural sustainability by beckoning the question – from what perspective are net-positive outcomes positive? She argues that biomimicry must start from within nature by allowing "nature to design us as well as our instruments" (2011, p. 10). In this way, human activities can have a generative impact for nature, where nature is no longer a stable category of thought, distinct from the human realm. In order to design from within 'nature's mindset', we argue that the conception of mimesis is a helpful element to consider as it is pivotal in framing the designer's relationship with nature. Thus, we introduce the second dimension (y-axis) to our Biomimicry for Sustainability framework, that spans from the 'strong' conception of mimesis to 'weak' mimesis.

By introducing this second dimension to our framework, each mapped example is reassessed in terms of the conception of mimesis inherent to the particular design and is thus shifted vertically to be repositioned within the new range. This reassessment, however, requires an extensive review of the design process for each example that takes on a heightened analytical sensitivity towards this discussion of mimesis. In order to illustrate our framework, we present below an initial visualisation (figure 05), in which we shift only a couple of examples, leaving the rest open for further deliberation.

In particular, we shift Neri Oxman's Silk Pavilion upwards by borrowing Fisch's (2017) discussion of her work as a neo-materialist approach to biomimicry by which design "emerges through inspirational technics of interaction with material nature" (2017, p. 806). Her work thus embodies a weaker conceptualisation of mimesis such that her design becomes an evolving process of thinking analogously with material nature, while the scope of the biomimetic promise remains within the more techno-centric realms. The example of Flectofin, on the other hand, is shifted down as the design process employed a 'strong' imitation of nature, by which "a valvular pollination mechanism was derived and abstracted from the kinematics found in the Bird-Of-Paradise flower" for the development of a hingeless flapping device (Lienhard et al., 2011, p. 1). Here, human epistemic sufficiency to 'know' and thereby reproduce nature is assumed, by which the

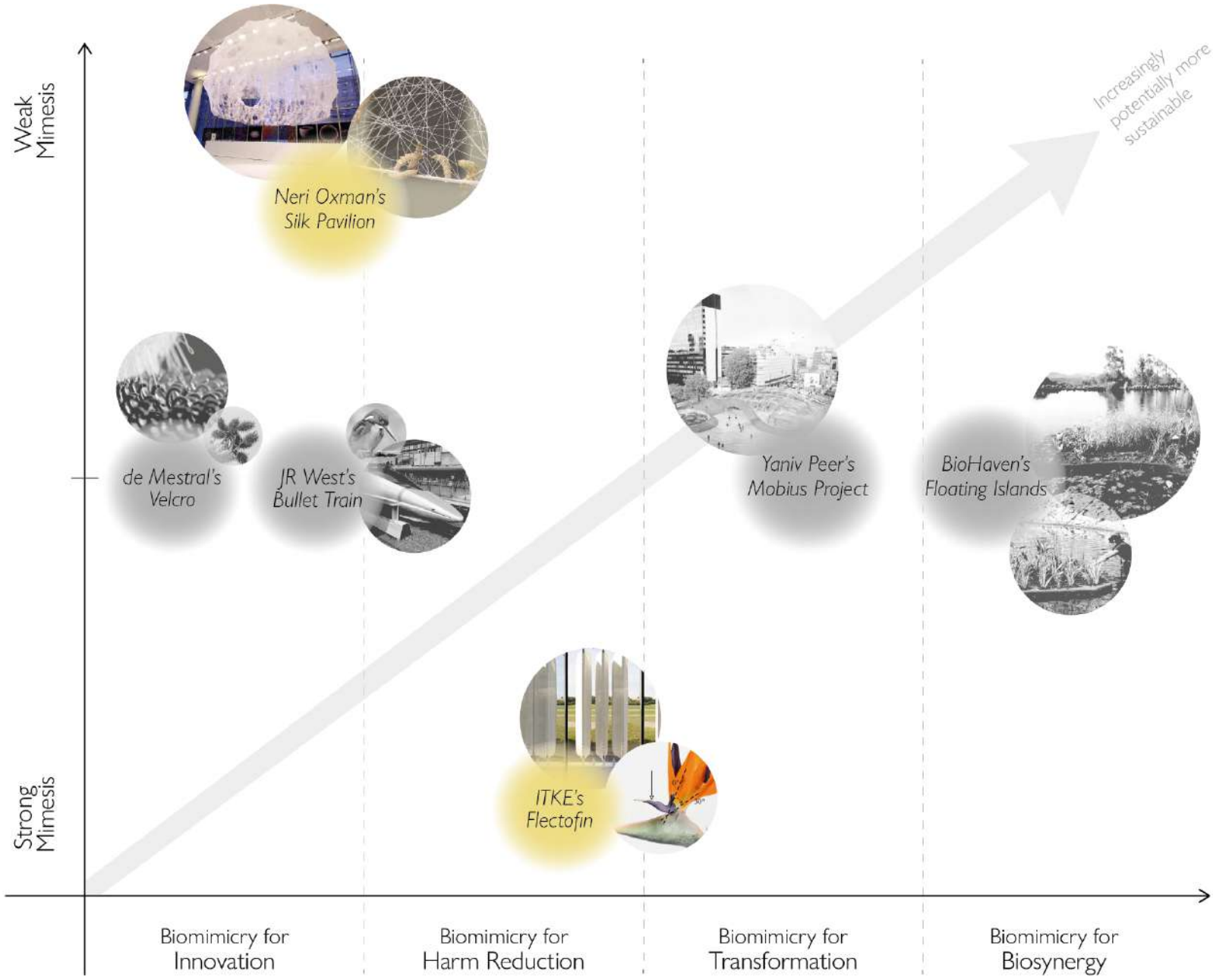


Figure 05: Biomimicry for Sustainability Framework. The placement of the black and white examples (Velcro, Bullet Train, Mobius Project, Floating Islands) have not been assessed in relation to the vertical range.

design aim becomes the scientific identification, categorisation, abstraction and deployment of 'natural design' for the benefit of human civilisation (Fisch, 2017). Thus, Flectofin is mapped as an example of 'biomimicry for harm reduction' that employs a strong conception of mimesis.

We thus present this framework as a possible direction for further theorisation of biomimicry and its application to sustainability challenges. By constructing this two-dimensional plane, we hope to contribute to a more reflective space for emerging literature on biomimetics that aims to expand its "focus on the technical translation of biological function" to also include explicit considerations of the methodological and ontological implications of biomimetics. We also invite the exploration of alternative possibilities for the choice of dimensional ranges as well as the introduction of perhaps a third dimension (which could be visually introduced via colour) that could explore possible correlations regarding the mimicry level of nature (i.e. form, process, ecosystem) as there is much debate in the literature surrounding the relationship between the various levels of biomimicry and sustainability promises.[10]

Along with the need of biomimicry's philosophical elaboration and development, identified in the literature and considered above, there are also calls for more experimentation, since little discussion is offered as to how these deeper elaborations of the concept can be applied in practice (Wahl 2006; Mathews, 2011; Goldstein & Johnson, 2015; Fisch, 2017). Active experimentation with the biomimetic process would further these conceptual developments by opening up a space for a form of methodological double-loop learning that positions biomimicry not only as the objective but as the object of study as well. Thus, we take a sustainable design approach to make our discussions of 'biomimicry for biosynergy', synergistic human-nature relations, and 'weak' mimicry experientially available through a collaborative design experiment. In this way, we navigate existing relations by mobilising the concept of biomimicry as a function for process-oriented urban greening activities around which we reconfigure new networks and open up spaces for new articulations of human-nature relations and sustainable futures within an urban context.

[10] Pedersen Zari (2015; 2018) and MacKinnon et al. (2020), for example, argue that ecosystem level biomimicry leads to more sustainable designs, distinguishing between mimicry of ecosystem functions and ecosystem processes.

design experiment | urban greening

As introduced earlier, along with our (now elaborated) starting point of biomimicry, we take the growing 'urban greening' agenda as our second starting point to contextualise and operationalise our experimentation with biomimicry. We begin first by discussing this general context of our experiment in terms of the exploration of synergistic human-nature relations and the urban greening actors with whom we collaborated. Through a navigational lens, we investigate the socio-material dynamics of the urban greening context, based on which we further develop our biomimicry deliberations in terms of principles for developing and staging a design experiment to test biomimicry as a function for process-oriented urban greening strategies.

The following chapters thus provide an overview of our design experiment as part of an urban greening strategy in Østebro, a neighborhood from Copenhagen. The experiment aims to instigate transitions of fundamental values and practices around urban nature by challenging the way urban greening activities are being carried out. The experiment is meant to support the development of a 'green network' in Østerbro which will be further expanded around a future art installation supposed to act as a symbol of urban greening activities in the neighbourhood. Our design work can thus be seen as an attempt to create the basis for experimentation with biomimicry within urban greening activities around the art installation. The latter wishes to support the binding of actors and narratives in a new 'green network' that challenges existing relations between nature and culture.

sensitivity

This section presents our sensitivity analysis where we explore the urban greening context and ways in which biomimicry could be employed in this context. We start out by investigating urban greening strategies in Copenhagen, and Østerbro in particular, to get an understanding of existing agendas, values and initiatives for urban greening. We then dive into the tensions and socio-material dynamics related to the specific socio-spatial context from which the green network is expected to flourish. Lastly, we present our initial conceptual and methodological considerations for biomimicry in the local context and how we translate them into an urban greening design experiment.

urban greening in Østerbro

Urban greening has become a widespread principle for rethinking and redesigning urban environments (Johansen & Lindegaard, 2020). In the City of Copenhagen, new policies and strategies have been developed to prompt the 'greening' of the city. The municipality has developed an overall vision towards sustainable development for 2025, which aims to set a general direction for how Copenhagen should develop "[..] holistically, interdisciplinary and long-term" (translated from Danish; Københavns Kommune, n.d.-a). Various strategies, such as, Copenhagen 2025 Climate Plan, Copenhagen Urban Nature Strategy 2015-2025, Copenhagen Tree Policy, have been developed to direct the city's responses to growing sustainability issues, namely climate change, biodiversity loss, decreased amount of wildlife, the quality and quantity of urban nature within urban development, water quality etc. (See Appendix 12). Within these strategies, and in particular, the city's urban nature strategy, urban nature is articulated as a 'multifunctional good' that can address human health and wellbeing, climate mitigation and adaptation, noise and air pollution, and biodiversity loss, with the ultimate mandate to create 'more and better' nature in Copenhagen (Johansen & Lindegaard, 2020).

Declared as the first climate-resilient neighborhood in Copenhagen, Østerbro is an exemplary case of the plural implications of urban nature, including extreme weather adaptation, improved air quality and local biodiversity, as well as improved quality of life for citizens (See Appendix 13). Recent developments in the district, such as Bryggervangen and Tåsinge Square, have shown

that the momentum to move toward a performative city-nature is growing and that the engagement of citizens is a key element to building and sustaining this momentum.

> *Especially in Østerbro, there are a lot of citizens that would like to participate in doing stuff for nature and about all this "save the world" kind of stuff. That is very modern in Østerbro.*
> (Signe - See Appendix 14)

As Laage-Thomsen & Blok (2020) point out, in Denmark, the past 10 – 15 years have seen the proliferation of new place- and practice-based urban green communities, as well as a growing call for civic engagement within municipal strategies. As suggested by Park Administrator of Outer Østerbro, Signe Dragenberg, "working with the people and trying to educate them and teach them about natural systems is really really important" as well as "making people understand what nature is and how we need to take care of it" (See Appendix 14). Local organisations like Miljøpunkt Østerbro and Kultur Ø, with whom we collaborated, have been acting as mediators between the two realms of local citizens and government [11], in an effort to establish a cultural movement around sustainability concerns and involve citizens in the transformation of the neighborhood. In other words, they aim to cultivate more sustainable human-nature relations, by which locals can have a generative impact on the city's nature, while simultaneously reaping the benefits of 'greener' urban spaces.

Specifically, Miljøpunkt Østerbro's core organisational values centre around sustainable behaviour and urban greening. They recognise a need to contribute to a political momentum for more wild nature and biodiversity in the city by involving citizens, since "[..] sometimes nature in cities is a compromise of wilderness and biodiversity and then functions for human use" (Lama - See Appendix 03). For Østerbro residents, nature has different shades: from tidy lawns for sports to intimate corners with flowers, but in the organisation's opinion, "[..] we have enough neat parks and need more areas that are untouched" (Lama - See Appendix 03). Thus, they have identified the importance in shifting people's values such that more space in the city is left for the development of 'wilder' urban nature.

In an effort to include citizens in these greening developments, Miljøpunkt Østerbro offers citizens the opportunity to create and care for small street gardens (gadehaver) in the neighborhood.

[11] See Mattijssen et al. (2018), Frantzeskaki et al. (2016), and Randrup et al. (2020) for further discussions on the increasingly interweaving roles of governance and civil society.

> *[..] we're thinking in terms of projects and teaching, how to design meaningful things, that have people learn, grow, take responsibility and feel empowered to act on environmental and climate issues.*
> (Lama - See Appendix 03)

Given their extensive work with citizens, including surveys, workshops, and community-led projects, they have observed a pattern – "people really want to green their city, they just don't know how" (Sara - See Appendix 03). Thus, a key goal of their work is the creation of a "green network" through which green associations, networks, and citizens can connect and collaborate on local sustainability projects (See Appendix 03). In other words, they aim to respond to the pattern they have observed by creating "a platform for people who work with sustainability in Østerbro and nature" (Louise - See Appendix 15).

Similarly, Kultur Ø, which is a network of institutions for motion, nature and culture in Østerbro, aims to create a city that lives and grows together with Copenhageners, through literature, sports, music, and creativity, by organising green activities and workshops regarding nature, food waste, biodiversity and urban greening (See Appendix 16). As part of the City of Copenhagen's Culture and Leisure Administration (Københavns Kommunes Kultur og Fritidsforvaltning), Kultu rØ received funding to develop a sculpture to inspire urban greening and become a symbol for the green activities and networks of Østerbro. In this sense, the sculpture represents a kind of material manifestation of Miljøpunkt Østerbro's vision of the green network. The two organisations have thus partnered in order to develop the green network as a relational outset for the art installation, which is planned to be built near Kildevældsparken, a small park located in Outer Østerbro (figure map of park in cph), where it is envisioned that many greening activities will take place in connection to the sculpture.

The sculpture is envisioned as a citizen-driven space where people can feel free to go and plant their plants or get inspired from it (Emilie - See Appendix 17) and as an opportunity "to spread more small gardens in the area" (Lama - See Appendix 03). The art installation has therefore been imagined as a 'mystical' garden-house (kolonihavehuset) to symbolise the green pulse of the neighborhood (See Appendix 17).

However, in line with Randrup et al. (2020) and Karvonen (2015), such strategies are often unable to gain the transformational momentum needed to move beyond unsustainable human-nature relations based on traditional views of nature in terms of either recreation or ecological science. We thus argue that space for deeper reflections and dialogue is needed to challenge conven-

tional perspectives on and relations with nature. In this way, nature in cities can become a much more dynamic and heterogeneous category of thought and tensions between anthropocentric and ecological values can become spaces for the exploration of synergistic approaches. Urban greening strategies can thus develop beyond outcome-driven initiatives, such as communal plantings of wildflowers, toward more process-oriented activities. And it is here that we see an opportunity for applying biomimicry.

> *I think this part of working with the people and trying to educate them and teach them about natural systems is really really important. [..] So this about making people understand what nature is and how we need to take care of it, I think it is very central in this [the presentation] and that's very very good.*
> (Signe - See Appendix 30)

Given the potential of biomimicry to cultivate co-creative partnerships with nature, we have set out to employ it as an interessement device around which we aim to assemble networks for process-oriented urban greening practices by staging a biomimetic design experiment that can expand the possibilities of future human-nature interactions in Østerbro. Based on our earlier discussions of biomimicry as well as our socio-material context, which is visualised below (figure 07), we have formulated our application of biomimicry in terms of principles that will guide the development of our design experiment. The table below illustrates these principles, outlining the plural discussions that have informed our choices as well as their practical implications on the design experiment.

To delimit our design experiment to a particular place, we chose the context of Kildevældsparken as the socio-spatial setting, given its key relation to the green network as well as the tangible relations between humans and nature inherent to an urban park. The following sections will explore the socio-material dynamics of this context, to further inform the design of our biomimetic experiment, which will be discussed subsequently.

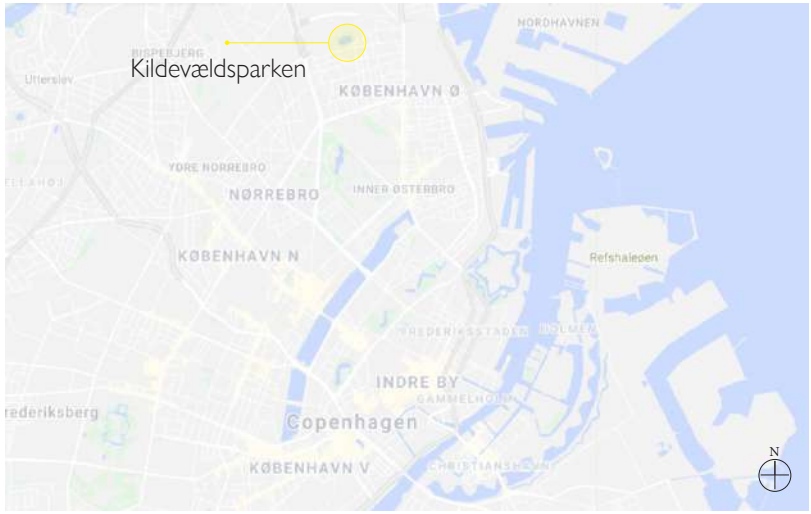


Figure 06: Map of Kildevældsparken in Copenhagen.

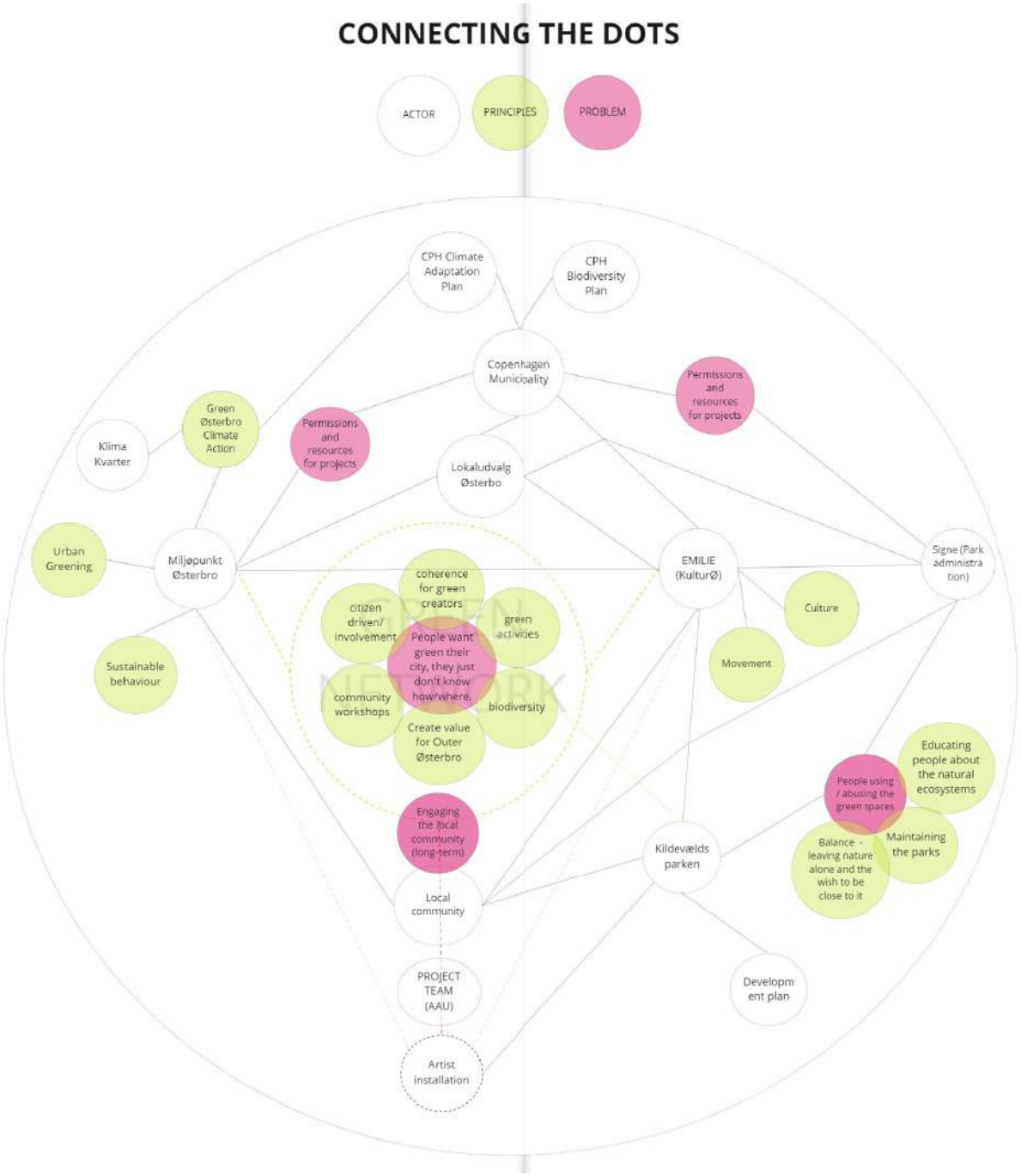


Figure 07: This figure illustrates an overview of the social-material context, including a legend, located at the top, indicating the categories represented by the coloured circles: in white, the human and non-human actors; in green, the principles reflecting the organisation's values; lastly, in red, the problems and issues which arose through discussions or while researching.

Box 3

	PRINCIPLE N °1 Positive feedback loops between humans and nature	PRINCIPLE N °2 Working with people
URBAN GREENING	Within the growing urban greening agendas, this notion of positive feedback loops is reflected in the plural implications of urban nature, whereby humans are taking direct action to regenerate nature in cities for human and ecological gains.	Engaging people in the process also responds to the growing trend of civic engagement in urban greening strategies and more specifically to our collaborator's role in these networks/relations. In this way, the cultivation of positive feedback loops between humans and nature can drive a societal-wide transition toward more sustainable urban futures.
BIOMIMICRY	The first principle is derived from our earlier discussion of 'biomimicry for biosynergy' by which biomimetic processes can open up spaces for the exploration of synergistic human-nature relations and interactions. Through these, humans can have a generative impact on nature and design from within nature's mindset. In this way, human activities are no longer bounded or limited by the dynamics of the Earth, but are rather holistically conceptualised as an integrated whole – one autopoietic system.	The second principle is a response to the dominant trend within biomimetic practice that largely limits its application to high-tech innovations and specialised experts. In this sense, biomimicry's novel lens is often kept within self-contained academic, technical silos. Thus, we argue for the direct engagement of (lay) people in the biomimetic process, such that the exploration of synergistic human-nature relations becomes experientially available for people, regardless of their backgrounds.[a]
SDE	This principle also relates to the recent sustainability and design debates surrounding the notion of net-positive approaches to sustainability challenges, that move beyond the limits and constraints discourse by focusing attention on the design of processes and outcomes that "contribute positive, mutually reinforcing, enduring benefits to human and ecological systems" (Robinson & Cole, 2015, p. 136).	Within sustainability and design discussions, arguments for participatory and collaborative processes are growing, which have informed our second principle. A fundamental element of procedural sustainability, for example, is the creation of discursive playing fields, by which sustainability can be co-constructed as "an emergent property of a conversation about desired futures that is informed by some understanding of the ecological, social and economic consequences of different courses of action" (Robinson, 2004, p. 381). This creation of discursive playing fields parallels the framing of design as a 'Thinging' practice, by which "Design Things enable people to gather and debate without requirement of expert knowledge, special skills, or predefined roles which make them valuable for creating controversy and opening spaces for new voices" (Munthe-Kaas & Hoffmann, 2017, p. 288).
DESIGN EXPERIMENT	A fundamental objective of our design experiment is to open up space for new articulations of human-nature relations that brings to light a synergistic framing around humans and nature.	Our second principle calls for a design experiment that engages various human actors in the process without requirements of expert knowledge or skills. Specifically actors who are or can be enrolled in the green network, so that the experiment can become embedded in and perhaps catalyse the existing momentum growing in Østerbro.

[a] An example of biomimetic intervention done together with (lay) people is the urban infrastructure project from Cape Town facilitated by two organizations: Actuality and biomimicry-SA (Novacek, 2016). The benefits of involving the community to think of the city as an ecosystem included citizens taking ownership over the project, being able to think holistically using

PRINCIPLE N °3	PRINCIPLE N °4
Working with local nature	**Making things**
The third principle is also rooted in the largely place-based strategies central to existing (civic) urban greening agendas, that bring to light their dependence as well as their influence on the socio-spatial context (Dorst et al., 2019).	Urban greening activities that engage people in a localised setting often centre around generative outcomes that allow participants to tangibly contribute to the socio-spatial environment, thereby empowering local citizens to take action on sustainability challenges. Material outcomes of urban greening activity practices also act as testimonies of citizens' work and can generate further interest and activities.
The third principle centres around the idea of a biomimetic process that engages people by focusing their attention on the non-human life around them. In this way, participants can be drawn into a dynamic dialogue with nature that they can interact with and so nature takes on a socio-material and discursive role in the biomimetic process. In this way, the human-nature relations that are brought to light are imbued with meaning for the people engaged in the process.	In order to draw citizens into a material and discursive dialogue with nature, we draw on Fisch's notion of nature as "an ecology of material iterations with which to think" (2017, p. 818). Thus, we introduce our final principle, 'making things', that calls for a biomimetic process that engages people in a materially tangible activity. In this way, the engagement of people in the process becomes generative and impactful for the situated place.
Focusing on place is also rooted in the discussion regarding the role of collaboration and participation mentioned above, as these processes also aim to uncover the socio-ecological stories of a place. In this sense, the local community and the place become key sources of information and perspectives to integrate within a project (Robinson & Cole, 2015).	Including generative materials in collaborative processes can catalyse collective creativity and give concrete presence to abstract ideas, concepts, and perspectives.
Our design experiment will situate people in a green urban space of their local context in an effort to bring to light their practices, perceptions and perspectives on nature and open local nature as a matter of concern.	Our design experiment will include a generative hands-on segment in an effort to tangibly translate biomimicry as an urban greening activity and to engage participants in a material rehearsal of possible synergistic human-nature interactions.

biomimicry principles, as well as co-creating future visions of the city based on lessons from nature.

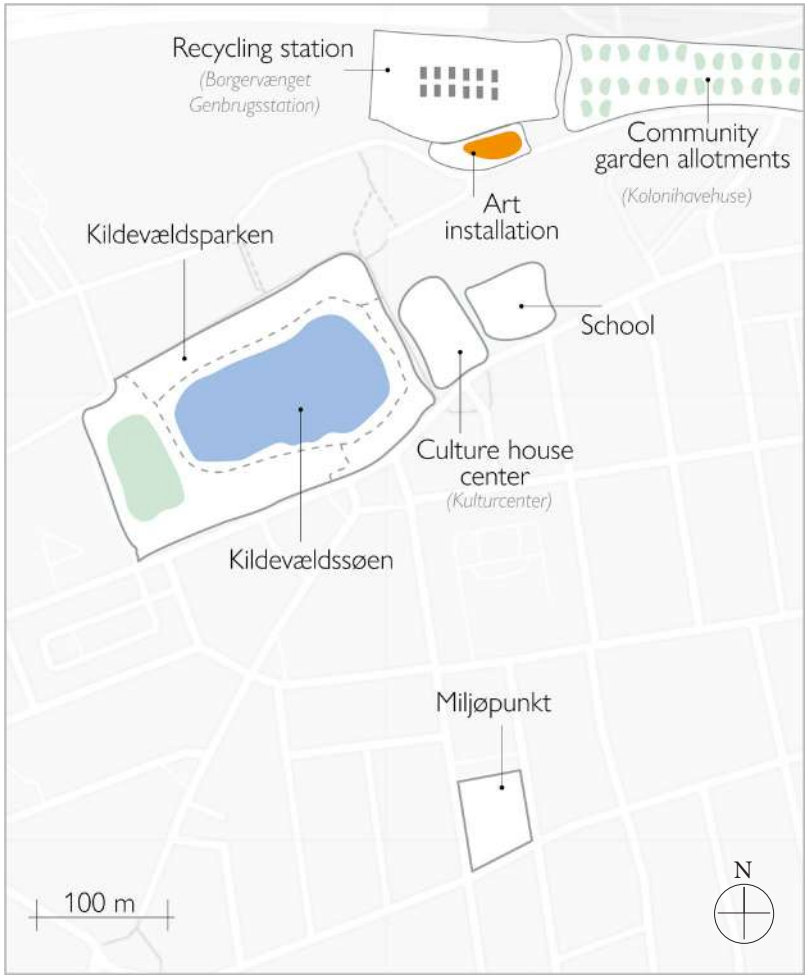
the social-spatial context

The art installation will be placed near Kildevældsparken, as it has a strategic location between other central actors in the neighborhood: Culture Centre (in Danish: Kulturcenter) Kildevæld (See Appendix 18), the Recycling Station, as well as the community garden allotments (in Danish: kolonihavehuse) nearby (figure 08). These actors play an important role in the network because they support the collaborators' visions of inspiring the local community with alternative practices in regards to urban greening activities that citizens could also do in their own garden, as well as repurposing waste.

Kildevældsparken is one of Copenhagen's smallest parks, located in Skt. Kjeld's neighbourhood of Outer Østerbro [12] (See Appendix 18). The central element of the park is the lake, Kildevældssøen, which fills most of the area (See picture on the next page). It is a man-made lake which arose in the 1890s when extensive excavations took place to procure materials for the building of the Frihavnen and Langelinjekajen, and large amounts of water flowed in from an underground aquifer (See Appendix 18).

Based on our investigations of the socio-material dynamics in Kildevældsparken, the development plans (Udviklingsplan) of the park, developed and issued by the Copenhagen municipality

Figure 08: Map of Kildevældsparken and the surrounding area.



[12] It is also important to note that Outer Østerbro became a focus for Miljøpunkt Østerbro and Kultur Ø's strategies for greening the neighborhood, since both actors noticed that in the past 5 years, the local community is more focused on bringing value to Inner Østerbro, marking a clear distinction between the two areas of Østerbro. Thus, they also work towards efforts that can demonstrate that Østerbro is much more than "moms that drink café latte" (Emilie - See Appendix 16) and that initiatives for urban greening could spread from anywhere.

(Københavns Kommune, 2013; 2019), play an important role. The development plans of Copenhagen's parks act as localised translations of the city's urban nature strategies, attuned to the local residents' perspectives and opinions (via public hearings) and the situated nature (via biological screenings and ecological analyses) (ibid.).

> *The udviklingsplan [development plan] of the park [...] is the mindset and the frame about what we can do and what we cannot do. So that's about quite a central planning tool of possibilities and restrictions, but the point is that there is no money attached to that plan.* (Signe - See Appendix 14)

Given our focus on human-nature relations, the development plan thus became a key source in our explorations of how these relations are framed and discussed in the dominant articulations of possible futures for the park. These articulations are often translated in terms of values, by which priorities for future developments are established, and which are categorized in distinct realms – recreational and biological - echoing Karvonen's analysis of urban nature projects and the dominant conceptualisations of "nature through conventional lenses of recreation and ecological science" (2015, p. 282). Perhaps this is a reflection of the organizational silos Randrup et al. (2020) point to regarding traditional urban nature planning and management and the growing calls for alternative modes of governance based on more integrative approaches[13]. However, given our highly localized and situated experimentation, we leave these discussions regarding human-nature conceptualisations within different modes of governance and its implications for sustainable urban development open for further deliberation.

Instead, we have focused on the socio-material translation of these categorical dualisms within our specific context and the socio-material dynamics of existing human-nature relations in the park. The following sections thus further develop on our 'sensi-

[13] See Buijs et al. (2016) for discussions on mosaic governance as a framework for understanding active citizenship and the possibilities for alternative organisational structures for governance.

tivity' of the given context to better situate our design experiment. In this analysis, we use multiple sources - in addition to the park's development plans, we also reference interviews we have conducted with the Park Administrator of Kildevældsparken, as well as written material from the design experiment.[14]

Kildevældsparken: nature as a framework for recreation

Based on the development plans and participant responses, the park is valued as a small breathing space that offers respite from the fast-paced city life, as "the green heart of the neighbourhood" (translation from Danish; Københavns Kommune, 2019, p. 8 - See Appendix 18 for more details) valued for "the nature and its peace within the city" (Felipe - See Appendix 19). This quaint image of the park is often contrasted to the nearby Fælledparken in terms of the space available for recreational activities and the general atmosphere of the park:

> In Fælledparken, which is located near Kildevældsparken, there are football pitches, areas for petanque and installations that encourage many forms of physical exercise. Kildevældsparken must offer a different and more calm experience."
> (Københavns Kommune, 2013, p. 9)
> *I usually go to Fælledparken where my kids can play and we can have picnics - more free space.*
> (Ilka - See Appendix 19)

Hence, calm recreational experiences and beautiful green spaces are formative of the Kildevældsparken's identity. This clear focus on recreation is emphasized in the plans:

> "Kildevældsparken is a framework for daily recreation for many citizens in the local area, and this is maintained as the park's primary purpose."
> (Københavns Kommune, 2013, p. 7).

With recreation positioned as such, the non-human life in the park is discussed either as a passive backdrop to human activities or in terms of biodiversity. The articulations of future developments of the park thus hinge on a clear distinction between recreational values and biological values.

Regarding recreation, nature is discussed in terms of 'green urban spaces' and human accessibility. In this way, nature is positioned as something for humans – the management and development of which becomes a technical service for human benefit (Randrup et al., 2020). This is also reflected in the plans' assessment

[14] In order to get first-hand empirical data regarding ways in which the local community perceives Kildevældsparken, we included Think Box activities in the beginning of the design experiment which were inspired by teaching practices in Aalborg University. The Think Boxes thus acted as means to collect empirical data before the biomimetic intervention with participants, in order to explore existing human-nature relations and how they change during the workshop. Since the participants were requested to give their input in writing, this exercise allowed us to extend our ability to do participatory observations while focusing on facilitating the design experiment. (See Appendix 19)

of the 'users' of Kildevældsparken, who are strictly identified and assessed as humans, keeping the family of blackbirds nesting in a linden tree, whose roots grow in the park's soil among the pulsating mycelium networks largely invisible. The non-human life of the park is thus reduced down to a passive setting for human use, whose development revolves around recreational opportunities (such as grilling tables) and aesthetic features (such as the park's 'sight lines' around the lake).

In a dialogue with the Park Administrator of Kildevældsparken, this focus on the aesthetic and recreational value of the park seems to be present in the discussions initiated by concerned locals:

> *I think that when people call, it is because they are angry about something. Unfortunately. That is often the functionalities, the benches, the garbage cans, the holes in the park or the mud [..] And it's not that many people that call with ideas and wishes about development about the green because it's not necessarily in their mindset. [..]*
> *Often they call or they write to me 'why don't you put more flowers on the lawns?'.*
> (Signe - See Appendix 14)

Similarly, based on participant responses regarding the changes they would like to see in the park, concerns centred around human-oriented features such as trash bins, benches, and opportunities for exploration:

> *Enough trash bins.* (Kasper - See Appendix 19)

> *I would enjoy if there was more to explore, more diversity, a cosy spot to sit. After surrounding the lake there's not much more to see / explore.*
> (Ilka - See Appendix 19).

Hence, given the recreational framing of Kildevældsparken, human-nature relations are often based on a static conception of nature - a stage on which human activities play out. Despite this passive understanding of the relationship, the non-human life of the park is more than a setting for human-use – it is a network of dynamic ecological interrelations in which humans have had and continue to have a clear presence, influence, and relation. So, in the following section, we give a brief overview of the existing human-nature relations that concern the ecological values of the park, in an effort to show that, despite the isolated considerations of the park's non-human life (as can be seen in the biological assessments that inform the development plans (Fiskeøkolo-

gisk Laboratorium, 2013), Kildevældsparken is a living network in which the natural world and the human world cannot and should not be treated separately.

Kildevældsparken: a holistic view on nature

The park's central element Kildevældssøen arose as a result of human excavations for building materials for the Frihavnen and Langelinjekajen, back in the 1890s. Due to its particular proportions, wooden banks were built to reinforce the steep edges of the lake. These wooden banks, which were recently renewed by the park administration (Signe - See Appendix 14), thus displace the varying gradients characteristic of natural [15] lake banks that provide a range of micro-habitats for various species (See Appendix 20). The amount of sun that reaches the lake floor is consequently reduced, resulting in virtually no vegetation in the lake, according to studies conducted by the Fish Ecology Laboratory (See Appendix 18).

Additionally, the recreational activity of feeding birds by the lake has resulted in an artificially maintained population of birds, especially waterfowl, that is disproportionately large to the size of the lake. This has led to an increased level of nutrients in the

lake (mainly from bird droppings), degrading the water's quality, and has also hindered the establishment of vegetation around the lake (since the birds trample and eat them at a faster rate than the rate at which the vegetation takes root) (Københavns Kommune, 2013; 2019).

The reinforced steep slopes, lack of vegetation, and disproportionately large bird population have thus contributed to the water's poor quality, low biodiversity, and high level of nutrients, as identified by the park's development plans. A fountain has been placed on one side of the lake to improve the water quality by circulating the water; however, based on the municipality's

[15] 'Natural' is used here to distinguish between a man-made lake and a lake formed via non-human processes such as the movement of tectonic plates, glaciers, or meandering rivers. See Hailwood (2000) for discussions on the notion of 'nature's otherness' and what it means for something to be 'natural'.

analysis of the lake, the fountain has only a small effect, mostly appreciated for its aesthetic value.

Nevertheless, the lake holds cultural significance as an aesthetic quality, contributing to the park's quaint and peaceful atmosphere, as well as a historical artefact - as a "a child of the time it was laid out [...] From its construction, the park got the shape it has today, and in the development of Kildevældsparken, the history that binds to the design of the neighborhood and the park must be taken into account" (Københavns Kommune, 2013, p. 37). The lake's cultural relevance and value is also exemplified in the legends told about the lake. One story tells of a spring in the area, whose water was believed to hold healing powers, and today it is imagined that perhaps the park's name came from this healing spring, whose water source might be the same as that of Kildevældssøen (ibid.).

More recently, a myth circulated around the park that told the story of the remains of an old railway system and tipper train lying at the lake's bottom, which were disrupted by the erupting waters during excavation (which formed the lake) and subsequently drowned. And in the summer 1993, the local newspaper, Østerbro Avis organised a diving team to investigate the depths of the lake, only to discover a pair of broken safes. Nevertheless, the myth has remained in the park as sculptural elements of segments of railroad tracks, installed in the Frisportet path along the north side of the park as shown in picture on previous page.

Additionally, since the removal of the fence that separated Kildevældskolen from the park, human movement has significantly increased between these two areas. During our interview with park manager, Signe Dragenberg, she commented on this development:

> *[The fence] was taken down because the school and kulturhuset wanted a better connection to the park. And I can understand that, but at the same time I can see that it also resulted in the people walking across into the bushes. And you can do that if you are five people, but when you are 500 walking there five times a day, then we cannot get the vegetation underneath the bushes to develop. So, this about leaving nature alone and the wish to be close to it, is a problem.*
> (Signe - See Appendix 14)

Hence, we see clear interactions and tensions between the cul-

tural, recreational, and ecological processes of the park. From the human-centred point of view, human-nature relations are quite passive in that nature is framed as the setting for human activities with very little consideration of the ecological consequences of these interactions. From the ecological point of view, these consequences are highlighted and treated as distinct references for park development objectives. As a result of this dualised perspective, the possibilities for cultivating synergistic human-nature relations are kept invisible by conventional processes of trade-off decision making considerations. In addition, due to the defining paradigm of Kildevældsparken as a recreation framework for human use, efforts of improving the biological values of the park seem to remain focused on aesthetics and benefits for human use (i.e. blooming bushes and rolling grass mats), rather based on a reflexive exploration of what nature really needs and needs us to want - a synergistic culture of engagement as Freya Mathews discusses it in relation to a river:

> "What a river, a world, wants of its people may be not merely pollution-dispersing agents but, I would suggest, an entire culture of engagement, whereby our sense of our own meaning becomes suffused with the meanings that the river, as a living system in its own right and a conative strand of the biosphere, has for itself. Such a culture of engagement is achieved when, in synergy with the river, we no longer think of it merely as ours but also think of ourselves as its — when we take our place in the river's world, and build our desires, our ends, on that premise."
> (2011, p. 13).

Existing human-nature relations in Kildevældsparken are clearly approached from two distinct realms that of the human world and the natural world. The former works with a static and instrumental conceptualisation of nature; while the latter frames human activity as a problematic presence in the park. Hence, we argue that Kildevældsparken should be brought forward as a matter of concern, by creating a space for the local community to reflect on and articulate new human perspectives and relations with nature and the potential cultivation of synergistic human-nature relations. Thus, our design experiment will mobilise the concept of biomimicry mainly as a process-oriented approach for urban greening. In the following section, we expand upon our translation of biomimicry with respect to the socio-material dynamics of our given context discussed above.

translating biomimicry in practice

Having our methodological and conceptual considerations as well as our principles as a point of departure in applying biomimicry in the local context, we started a dialogue with our collaborators to explore how the generalized problem driven biomimetic process , illustrated in figure 02 could be adapted for the design experiment - to be staged as a biomimicry workshop for urban greening.

In the endeavour of finding out at which point in the biomimetic process it would be the most relevant for citizens to be involved through the design experiment, we discussed with our collaborators potential alternatives (see figure 09). The idea of having possible alternatives instead of the whole process derived due to time constraints, as well as our collaborators' concern that citizens might get overwhelmed from being involved in the whole process:

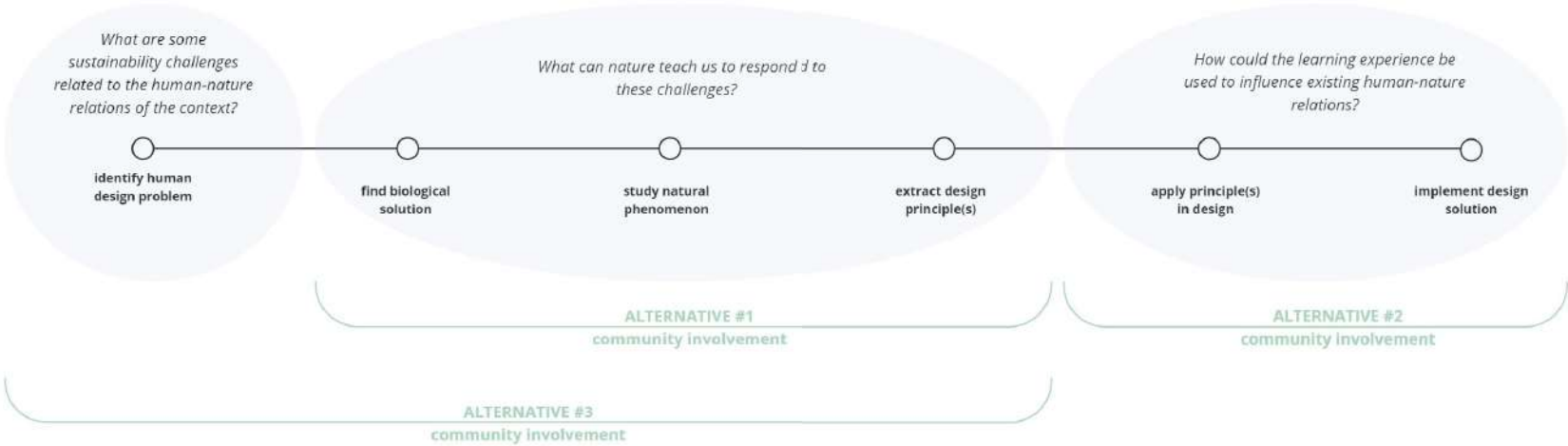
> *[..] it's always nice to hear what the citizens are thinking and how they understand it, but what I think this about biomimicry, I can say, though, I mean, it's a new way of thinking for a lot of people. So it can be too abstract.* (Emilie - See Appendix 21)

As it can be seen in figure 09, the idea was to first rethink the generalized steps of the problem driven biomimetic process as questions that could help participants in the design experiment to inspire a more reflexive and experimental approach to biomimicry.

Thus, the first step of defining a design problem was reframed as a question to invite a variety of articulations of the issue: "What are some sustainability challenges related to the human-nature relations of the context?". Similarly, in the next steps that move into nature's realm, we formulated the question: "What can nature teach us to respond to these challenges?" to reflect a more open and flexible (or 'weak') approach to emulating nature. Finally, when stepping out of nature's realm to apply principles abstracted from nature in design solutions, we ask "How could the learning experience be used to influence existing human-nature relations?".

In Alternative 1 and 2, the ideas proposed were for the problematic socio-material dynamics in Kildevældsparken to be identified beforehand by the design team and be presented to citizens

Figure 09: This visualisation shows the alternative options for involving citizens in the workshop steps, which we used in our discussions with the collaborators.



through workshop activities, so that we would either (1) explore together with citizens the lessons that we can learn from nature after which the design team would use their input for developing design proposals and implementation strategies or (2) the design team studies the lessons from nature as well and have citizens only co-design solutions at the workshop.

In Alternative 3, the focus would be on involving citizens in the first part of the biomimetic process, for identifying the problematic socio-dynamics in Kildevældsparken and exploring lessons that could be learned from nature.

Upon discussing these alternatives with our collaborators, we settled on having a combination between Alternative 1 and 2, due to our principles of having participants study the local nature and work with their hands, but also the collaborators' priority of having a physical outcome :

> *It's not just something theoretical or something that you get more information about, but you can actually end up with a product.*
> (Signe - See Appendix 22)

Nevertheless, it is important to note that in this research, the design experiment is not centred around the design of a biomimetic outcome, but rather emphasizes reflexive experimentation with a biomimetic approach to urban greening which involves a practical activity of co-creating and exploring possibilities by making material things with participants. However, the outcome, as seen from our collaborators' perspective, could be interpreted also as a potential interessment device for mobilizing participants in the green network, as well as future design experiments:

> *[It is an] involvement that kind of keep(s) them interested. [..] afterwards you can go and say, "Hey, we made that one!", [..] so you can kind of see actually something coming out of it.*
> (Signe - See Appendix 22)

During the discussions, we also introduced a preliminary brainstorm of biomimetic interventions as an interessment device to get our collaborators enrolled in our thoughts for the design experiment. We thus proposed some biomimetic interventions that already exist and could be replicated as part of the workshop, as well as some biological strategies which could be applied to the tensions identified in the local context.

Our collaborators got excited by the possibilities, and since we decided that the design team, meaning us together with the collaborators, will identify the design problem beforehand, we chose the lake to be a coherent focus as a tangible manifestation of problematic human-nature relations and considerations of Kildevældsparken. In particular, the lake is an aesthetic quality for the park, holding cultural relevance through legends and recreation, while simultaneously holding particularly poor biological value regarding the flora and fauna, level of nutrients and biodiversity.

Thus, based on our research we proposed the installation of biomimetic floating islands on the lake as the tangible, prototyping aspect of our workshop given our scope (regarding participant engagement, timing and funding), to which our collaborators agreed:

> *I would like to deal with the islands on the lake and so on, because I think it gives such a good picture [in Kildevældssøen]. I didn't know that was so important and for me it was just a lake.*
> (Emilie - See Appendix 22)

> *I think also I'd kind of fall in love with the idea of this small floating island in the middle of the lake, because it's a new thing and it's isolated and you can actually build it.*
> (Signe - See Appendix 22)

> *Yes, it sounds really interesting, especially if it is that they end up having this actual product that will be put into the lake and that they helped create.*
> (Louise - See Appendix 22)

Moreover, the collaborators were more thinking about these possibilities in terms of practicalities and how they would interfere with other actors in the network such as gardeners, but also the development plan:

> *So for me at the cultural part and creating this green network with Louise, it could be whatever we are allowed to.*
> (Emilie - See Appendix 22)

> *And also I think it would be good to ensure that it is an isolated project rather than something that interferes with the maintenance of the park, because then it becomes more complicated.*
> (Signe - See Appendix 22)

In addition, since floating platforms were built before on Kildevældssøen and were part of the development plans, floating islands presented an opportunity for the design experiment to focus "on reconfigurations of the existing rather than radical invention of the new" (Munthe-Kaas and Hoffmann, 2017, p. 287). In contrast with the wooden platforms built previously, the contribution of this design experiment was to focus on biomimetic floating islands that take wetlands as a biological model for their design, as exemplified previously in Box 1.

The following section further expands on the floating island prototype as a biomimetic innovation.

floating islands

Following the generalized steps of the problem-driven biomimetic process, we analyse and visualise below how the biomimetic floating islands could be made, in order to be able to reproduce the innovation together with citizens.

defining the problem

Expanding human populations have direct negative impacts on many aquatic environments, leading to poor water quality and biodiversity (Stewart et. al, 2008). The problem in our case could be seen as both the human lifestyle and the poor water quality (ibid), thus, through our design experiment we aim to tackle both problems with citizens - first as part of reflecting on the question "What are some sustainability challenges related to the human-nature relations of the context?" and second by engaging them in a biomimetic intervention for water treatment. In order to tackle and define the poor water quality problem, in the case of Kildevældssøen, a technique that could be employed is functional decomposition (Helms et al., 2009). This implies that a complex function such as improving water quality could be decomposed into sub-functions such as removing nutrients, increasing oxygen level or enhancing biodiversity.

reframing the problem

Since the sub-functions identified as part of defining the problem are already in biological terms, this step can be skipped or revisited at a later stage if biological models are difficult to find.

searching for a biological solution

As the problem is defined in terms of function, the online library developed by the Biomimicry Institute, AskNature, could prove to be a suitable way to search for biological models as it indexes biological strategies by function (Biomimicry Institute, 2016). In this case, only searching for the function "remove nutrients" already yields wetlands as the first suggestion (Biomimicry Institute, n.d.-d). Wetlands are considered to be some of the most productive ecosystems on Earth in sustaining biodiversity, as they support plant and animal species during key stages of their lifecycle and help with cleaning and recycling water (European Commission, 2007). However, they are also the most threatened ecosystems due to human activities such as agriculture, infrastructure developments, building of dams, etc. (ibid.) (See Appendix 23 for further insights).

abstracting the biological solution

So far, the focus in the literature has been mainly on abstracting wetlands' functions to remove pollutants, especially nutrients, from the water as well as enhancing biodiversity (Samal et al., 2019). For the design experiment we decided to abstract the same wetland functions [16], since these were respond to the main issues identified in our local context as well (See Appendix 24 for a visualisation of nutrient amount in Kildevældssøen), but also because our biomimetic intervention was meant to be a pilot project, based on which more interventions could be done in the future to explore other possibilities.

Nutrients (e.g. nitrogen and phosphorus) are being assimilated and removed by natural wetlands through some key role players. Phosphorus (P) is mainly "recycled and reused by bacteria and small phytoplankton and over longer periods by zooplankton in open water" (Dama-Fakir et al., 2018, p. 44). The formation of algae is a common issue in stagnant water bodies as they thrive on excessive phosphates resulting from excessive organic matter in the water. Thus microorganisms that attach to root systems of wetland plants either assimilate P and starve the algae, or some microorganisms such as Daphnia even feed off algae, hence stopping them from forming (Dama-Fakir et al., 2018). These microorganisms form communities by attaching to each other and stable surfaces, which lead to the formation of biofilm (Samal et al., 2019). Biofilms are slimy and sticky, consisting of cells and the extracellular matrices produced by cells (ibid.). This makes them able to entrap suspended solids from water, but they also "[..] provide mechanical stability, enhance water retention, improve nutrient absorption, give protection against viruses and possess antimicrobial activity." (Samal et al., 2019, p.2).

Nitrogen (N) is absorbed and removed from the water due to high productivity of wetland plants (Dama-Fakir et al., 2018). "Nitrogen compounds are reduced to nitrogen gas which is released into the atmosphere." (Dama-Fakir et al., 2018, p. 44). The nutrients assimilated by wetlands are thus consumed by megafauna such as birds and other animals, allowing them to be redistributed thereby maintaining ecosystem balance (ibid.).

Regarding biodiversity maintenance, wetlands are considered to be biodiversity hotspots as they provide the perfect conditions for a vast diversity of life forms - from microbes to macrophytes [17] and fauna species (ibid.). For fauna species, such as birds, dragonflies and amphibians, wetlands are vital for nesting, while the same goes for flora species, since particular plants depend on ecological conditions characteristic of wetlands (European Commission, 2007).

[16]
It is important to mention that wetlands have many other functions as they are very complex ecosystems (See Appendix 23 for an overview of other wetland functions). As Dama-Fakir et al. (2018) argues, the overall design and performance of the floating islands depends on a deep biomimetic process where the natural wetland system, functions, critical components and interdependence of the various components should be explored by interdisciplinary experienced teams. Nevertheless, due to time constraints, our research was only based on literature and not on extensive collaboration with relevant experts. Since the design experiment was meant to have the main focus on the process, not on the perfect biomimetic outcome, we left these discussions open for debate with the participants instead, with the possibility of having expert collaboration in future interventions. Hence, we took this as an opportunity to explore what participants think about wetlands functions during the design experiment in order to prompt deeper reflections on human-nature relations as well as what consequences their actions during the workshop will have in the given environment.

[17]
The aquatic plants which are growing in or near water, thus present in wetlands, are known collectively as macrophytes. This distinction is made in order to differentiate them from microscopic algae and other microphytes (Favas et al., 2016)

extracting and applying design principles

In order to be able to craft our own biomimetic floating island during the design experiment, we researched existing literature for the main design principles, abstracted from wetland functions (see Appendix 23 for more details). We also consulted with providers of BioHaven® Floating Islands to discuss our case study with their research teams. The final design principles extracted have been incorporated in an initial prototype, whose exploded view can be seen in figure 10.

The prototype was done prior to our meeting with the Director of FROG Environmental Ltd, a provider of the BioHaven® Floating Islands from the UK [18], in order to familiarise ourselves with the materials and process before we guided the participants.

In contrast with the BioHaven® Floating Islands and many other inventions that use recycled plastic bottles as material for the floating bed, we chose to focus on using organic materials. This is due to our priority of having participants in the design experiment connect with nature and work with their hands on building solutions from nature, for nature. Furthermore, since the vision of our collaborators included inspiring citizens with ways of repurposing waste through urban greening activities, we had the idea of repurposing garden waste (to the extent possible) for building the floating islands. However, the materials were also carefully chosen based on our research.

When presenting our prototype to FROG Environmental Ltd, we got very positive feedback, as it turned out that they are currently researching alternatives for the plastic floating bed as well:

> *"It is very important to have these discussions with citizens and I think it is a very valuable project if you are going to show them how to make the floating islands themselves and the implications they have for the lake" (Richard - See Appendix 23)*

We also got valuable insights in regards to the thickness of the growing medium (which Richard recommended to increase, while ensuring access for the roots to keep in contact with the water), maintenance (which he informed us did not need involve the harvesting of plants since most of the nutrient uptake is in the biofilm - See Appendix 23) as well as future directions for monitoring (keeping track of the plants that are thriving in the given conditions, as well as quantifying changes in the water quality).

[18] We initially reached out to the Danish provider Vegtech, but we did not have any luck in reaching their research team.

Previous attempts of using wetlands as a biological solution

There has been an increased interest in the literature to reproduce these ecosystems as systems often referred to as constructed wetlands (CW), which have a specific focus on the functions for improving water quality while supporting biodiversity (Stewart et. al, 2008).

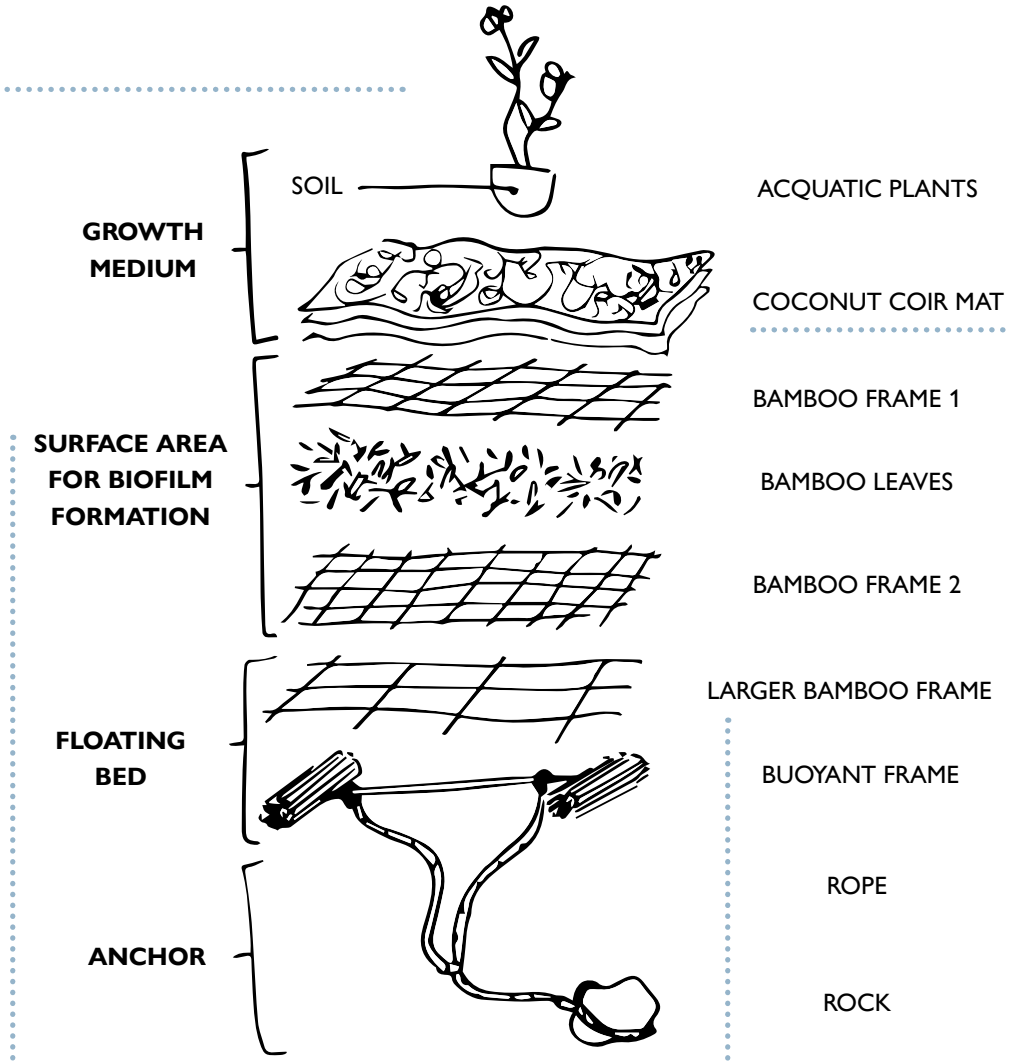
Constructed Floating Wetlands (CFW) are variants of Constructed Wetlands and have been researched under different terms, such as 'planted floating system beds', 'artificial or vegetated floating islands' or 'ecological floating beds' (Pavlineri et al. , 2017). CFWs have been inspired by naturally occurring floating wetlands, also known as free-floating mires or islands, which are floating ecosystems consisting of emergent plants rooted in an organic buoyant mat that forms on the surface of the water (Zaccone et al., 2017). Their existence depends on a sequence of natural conditions of the water where they form, such as low depth, high mineral content, low oxygen content to slow decomposition of dead plants, etc. (Overbeek et al., 2020). Hence, CFWs are still a major challenge to design in a way that mimic the formation process of natural floating wetlands due to biomass production and decomposition that needs to be synchronized with the colonization of peat-forming species within a controlled time frame (ibid.).

For this reason, this is where biomimicry has the potential to come in and achieve enhanced functionalities for the CFWs, since a biomimetic approach does not only seek to reproduce this ecosystem the way it occurs in nature, but involves an interdisciplinary process where functions of natural floating wetlands can be first abstracted and then engineered to find possible solutions.

An example of CFW created using a biomimetic approach for nutrient uptake and biodiversity maintenance is BioHaven® Floating Islands, shown in figure below (Biomimicry Institute, 2005). According to Floating Island International (2016), the company that developed the technology, these floating islands are much more efficient to remove nutrients than the traditional constructed wetlands. In contrast to the traditional CFWs, in the BioHaven® Floating Islands, the roots of the plants together with microbes grow in and within the floating platforms, after which the roots extend into the water, which gives more surface area for larger bacteria population and thus, more nutrient uptake (Stewart et. al, 2008). The floating platforms act as an ideal medium for structured microbial activities, also called biofilms, which play a vital role in nutrient removal (ibid.) (See Appendix 23).

BioHaven® Floating Islands (Floating Islands West, n.d.)

Figure 10: Exploded version of the floating island prototype



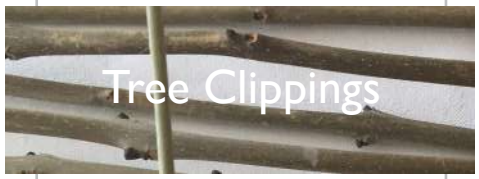
First, *we looked for suitable plants in the garden centers available in Copenhagen. According to Samal et al. (2019), the plants should be native, non-invasive, but also aesthetically pleasant and able to sustain themselves at the water depth that they will be exposed to on the floating bed. The aquatic plants that we managed to find were only having their genus mentioned on the label, not the exact species name, thus we did our own research based on the genus name of the plants (See Appendix 25). According to the information we found, they all had species in the genus that were suitable to Denmark and could naturally be found in Danish wetlands. In addition, we reached out to the shop assistants who confirmed that the plant species that they sell are native to Denmark.*

Second*, we chose a biodegradable growth media for plants and microorganisms, made out of coconut fiber adjusted with the soil that the plants came with. The coconut fiber was chosen because it is dense enough to keep the soil from falling into the water, while porous enough to allow exchange of air. In addition, it does not retain too much water hence having a minimal effect on the buoyancy of the island, but it is also a suitable material for sustaining plant growth and microbial diversity (Samal et al., 2019). This material has been bought from a building materials store in Copenhagen.*

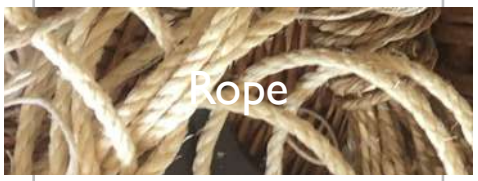
Third*, we accommodated biofilm formation by adding bamboo leaves and thin branches in between two bamboo frames as a way to increase the underwater surface area. Bamboo was the main material used as it is hydrophobic and enhances bacterial adhesion process (Samal et al., 2019). This was harvested from our own garden, as well as collected from old garden waste.*

Finally*, the floating bed was made from a larger bamboo frame with bamboo clippings tied together and attached on the frame for buoyancy, while the anchor was made out of a rock tied with rope to the frame.*


Aquatic Plants


Tree Clippings


Coconut coir mat


Rope


Stones


String


Bamboo Leaves


Garden Shears


Bamboo


Scissors


Green Bamboo


Gloves

prototype

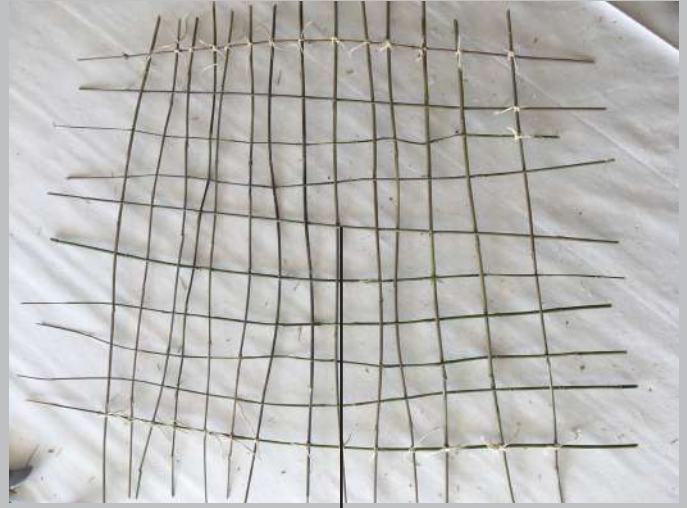



















Even though we managed to establish contact with FROG Environmental Ltd, a concern for building floating islands with citizens that was also shared by our collaborators, was the need of having an expert that could be present at the design experiment, and ideally help with developing the workshop activities.

Thus, we reached out to another key actor who is part of Nordic Biomimicry organisation and co-founded the Biomimicry Hub Denmark (See Appendix 04), Lars Pødenphant Kiær. Lars is "[..] a plant biologist focusing on ecology and evolution" (Nordic Biomimicry, n.d.). During our first meeting with him - which we held on-site in Kildevældsparken - we introduced our project and discussed with him our use of biomimicry, in an effort to get feedback from him as an ecologist/biologist, educator and biomimicry expert and to ultimately enrol him as our workshop expert. Luckily, an unexpected window of opportunity presented itself – Lars had recently decided to pursue his biomimicry work full-time centring around the application of biomimicry through events, courses, talks and hands-on workshops in nature to stimulate discussion and reconcile views of nature. Thus, our project became an opportunity for him as well and so our expert was enrolled.

During our dialogue about the design experiment, we discussed with Lars the issues that we discovered in Kildevældsparken in order to establish a general problem from a biomimicry perspective. As Lars pointed out, the problem in this case should not be isolated to only particular issues like high levels of nutrients in the lake, but instead considered holistically at the ecosystem level. Thus, we agreed that the general problem could be seen as the low level of elements, and implicitly connections between elements, in the ecosystem of Kildevældsparken which makes it less stable than a natural freshwater ecosystem. Hence, the lake requires a high level of maintenance (i.e. wooden banks, fountain for oxygen, removing algae from the water etc.).

While establishing the general problem, we got a few insights regarding the biomimetic process for our context. The conversation led us to the idea that the linear biomimetic process discussed with our collaborators (see figure 09) could be turned into a circular one that better highlights the iterative nature of biomimicry, but also the fact that ecosystem biomimicry is a continuous process that could virtually never end. Thus, the reformulation of biomimicry aimed to mimic a spiral iteration (see figure 11), to show that even though our design experiment will touch upon one revolution, it opens up the space for future revolutions, for which urban greening activities can become a vehicle.

The process background is divided into two main areas: the 'context' on the left side and 'nature' on the right side (see middle part of the figure). Likewise, in the centre of the figure, we divided into two other spheres: biology, transitioning the process towards nature's side, and design engineering, back towards the context side. Inside the context, the steps have been separated between the design team and community involvement. As discussed previously with our collaborators, the design problem is to be defined prior to the design experiment in order to get a deep understanding of challenges related to the human-nature relations of the context. After this step, citizens should be involved in activities that could help them 'see' the problem and open up a space for their articulations of the issue. The following steps of the process that run through have been adjusted based on our own experience of building the floating island prototype.

Reading the figure from left to right, we start by defining the design problem, which means the specific design problem on site - such as the human-made lake. We then generalize the problem – in this case the lake - which means abstracting the problem in a biological way, by taking into consideration the idea of a (natural) lake. Following the circularity, we define the general problem, which in this case is the absence of equilibrium and positive feedback loops in the ecosystem of the park. Moving on, we explore solutions from nature - particularly of freshwater ecosystems (for instance, looking at biological models that recycle nutrients, support vegetation, the circulation of water and so on). Based on these, we choose a biological solution which we study and abstract functions relevant to the general problem. The functions are then used to extract design principles and explore their possibility of being applied as solutions in the context. The bottom-most point of the circle represents the shift from the sphere of 'nature' to 'context', by means, from the field of biology to design engineering. Here we enter the part of the workshop which is focused on developing the solution and making it tangible by crafting a prototype which aims to change (and hopefully improve) the context in which it is being tested.

Upon building solutions and testing them in the local context, these have an effect on the ecosystem where they have been added and thus there is a need of observing, reflecting and assessing whether the general problem has been tackled. Since this process is particular to urban greening, we are only referring here to ecosystem biomimicry and how developing one solution will act as only one node in the ecosystem which can have limited functions that are being mimicked at a time, hence there is always room for improvement and reflection. The floating islands should

thus be seen as one solution out of many that could help enhance connectivity in Kildevældssøen's ecosystem.

While shifting our perspective, we noticed how the biomimetic process itself could be a dialogue between culture (the context) and nature which, in this case, is being facilitated by disciplines like biology and design engineering. Thus, our four principles (illustrated in the middle of the figure between context and nature) are to be employed throughout the whole process as a way to challenge existing culture-nature relations and facilitate the design experiment.

However, this biomimetic process should not be seen as conclusive, as we aim to keep it open for exploration during the design experiment. Hence we merely open the discussion on how this process could be visualized to support workshop activities with citizens.

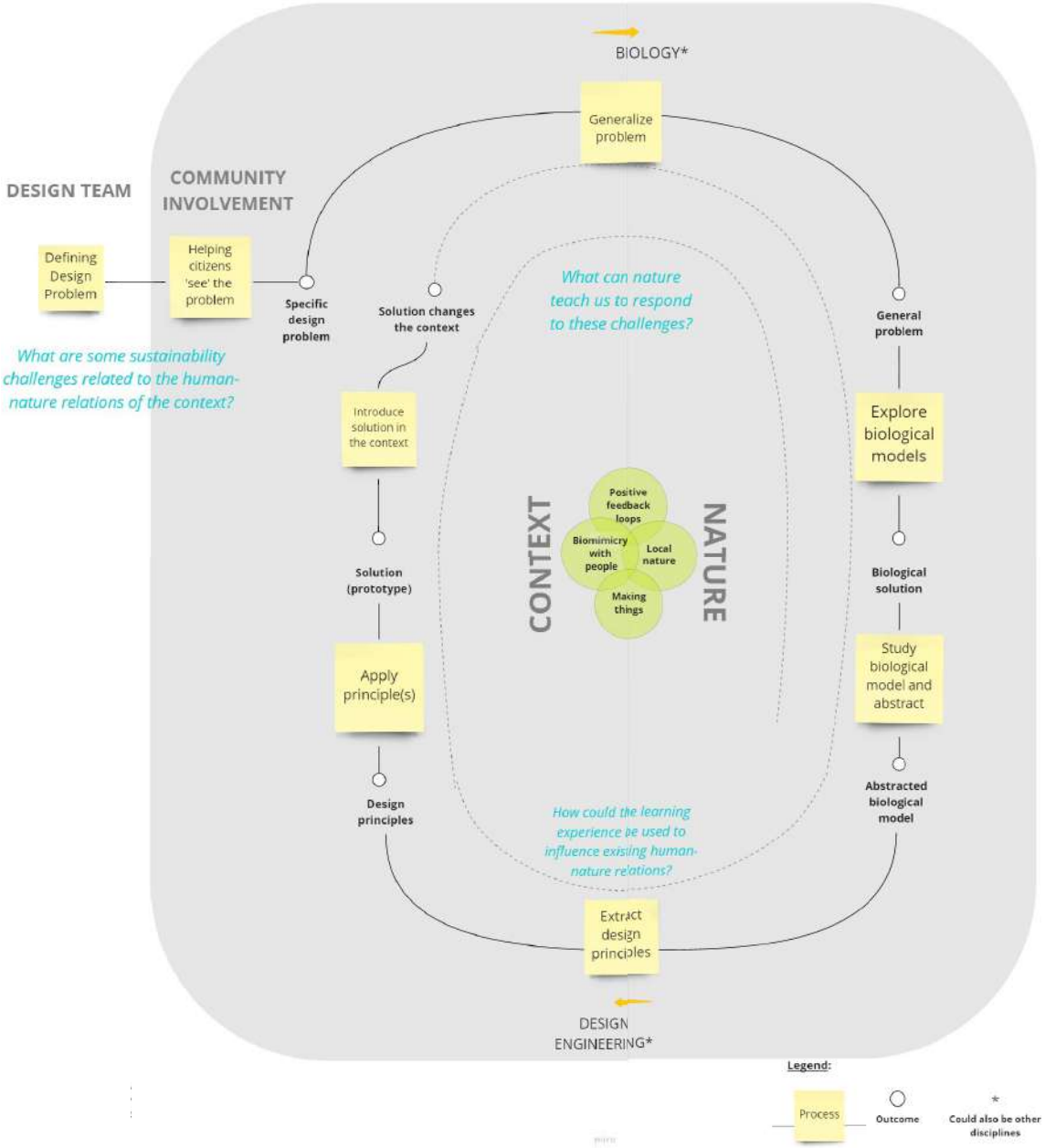


Figure 11: Re-visualisation of the linear biomimetic process into a circular representation for staging the design experiment.

staging

The following sections describe and analyse the design experiment staged in the socio-material context as a way to unfold the black-boxed issues (Munthe-Kaas and Hoffmann, 2017) between human-nature relations and to explore alternatives that could be implemented through a biomimicry understanding. Through the staging lens, we performed an activity of "prototyping practice rather than work with prototypes" (Munthe-Kaas and Hoffmann, 2017, p 293), which gave us the ability of making visible the invisible.

staging script

The experiment was staged as a three-hour workshop at Kildevældsparken on a Saturday morning, for which we developed a detailed plan. The plans' agenda had been thoroughly designed and structured to "include scripts for instructing the participants and time estimates for every activity." (Sanders, 2020, p. 65). The overall workshop was divided into two main parts: in part A (theoretical) we briefly presented biomimicry, the context in which we were in and the elements around an ecosystem, represented by the top half of the circular process visualised in figure above; in part B (hands-on) we staged a biomimetic activity to craft together with the participants, taking the participants through the bottom half of the circular process. The workshop plan included all the activities needed to prepare, facilitate and document the experiment. We prepared this in detail and discussed it with Lars and our collaborators beforehand, so that everyone on our facilitation team would know "[..] what will happen, where it will take place, how long it will take and who will be involved" (Sanders, 2020, p. 59). Each activity was estimated with an approximate timing (to help us be in time within the three hours) and had a detailed description as well as a defined purpose; we designed how the board would develop and how the facilitating roles would take place. However, we still left the workshop plan open for the unexpected and invited Emilie, Sara, Signe [19], and Lars to the workshop as experienced facilitators to address the unexpected (Sanders, 2020).

We designed the workshop based on the biomimicry process (see figure 11 above) by presenting a simplified version (see figure 12 - simplified version) and the biomimicry principles (see Box 3). As mentioned previously, the design problem was pin-pointed beforehand with expert knowledge from Lars, so the first part of the workshop was meant for making participants realise the

[19] Signe was unable to attend the workshop due to conflicting schedules.

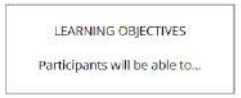
Part A

Activity

Board Development

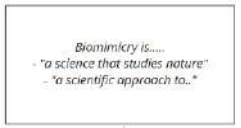
A.1 ICE-BREAKER 15min

1.1 GDPR format + ask emails + might contact again for more insights.
1.2 Everyone gets a blank name tag to fill in.
1.3 Think Box #1 - ask participants to write down, after writing their name tag, their opinion about Kildevældsparken and what would they do there, what issues do they see.
1.4 We go around and everyone introduces themselves.
1.5 Present the plan of the workshop and the learning objectives of the workshop.



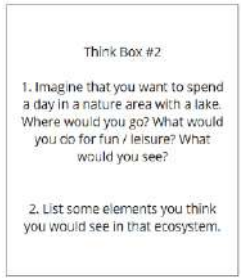
A.2 BIOMIMICRY 10min

2.1 We ask quickly participants: Has anyone heard of biomimicry? Anyone want to share what they know about it?
(In the meantime, we take notes and write down their definitions/ keywords on the board)
2.2 Based on the discussion we give general definition of biomimicry and the types based on the phenomena being under study (e.g. organism, ecosystem etc.)
2.3 Introduce top-down and bottom-up approaches and draw out the top-down process that we will be doing.



A.3 LAKE INTRO 10min

3.1 Based on the top-down process we present to them, we make clear that the first step of the process is to identify the (design) problem - so this what the first part of the workshop is going to be.
3.2 Think Box #2 - ask participants to write down an experience they remember from a lake.
3.3 Divide participants into two groups, and have them discuss with each other their Think Box entries (we tell them to feel free to use their phones to show pictures, maps, etc.).

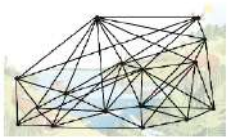


Activity

Board Development

A.4 LAKE SKETCH 15min

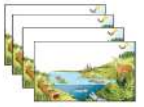
4.1 We introduce the term freshwater ecosystem to give the bigger (biological) context of a lake. (i.e. a lake belongs to a freshwater ecosystem). Mention habitats and microhabitats as elements and briefly explain their importance.
4.2 Ask participants if there are any elements missing in the drawing mentioned in their Think Box and Lars' insights. We fill-in the drawing and then we place tracing paper on top of the sketch and start discussing the relations between the different elements, drawing a node and line for each.

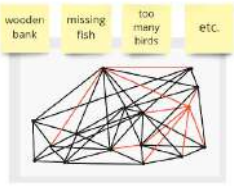


BREAK 10 min

A.5 SPOT THE DIFFERENCES 20min

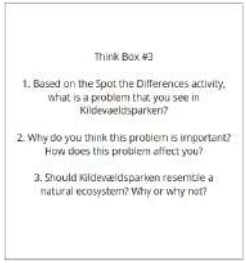
5.1 We introduce the "spot the differences" activity, dividing the participants into groups and giving them the option to walk around the dock to spot differences between the ecosystem drawing and the ecosystem of the park.
5.2 After telling them a few facts about the park history (man-made lake, depth etc.), the participants start the activity.
5.3 When the participants reconvene, we ask them to share their observations and for each observation we discuss how it affects the relations in the ecosystem and we mark it on the network drawing.





A.6 GENERALISE PROBLEM 10min

6.1 Think Box #3 - Participants individually will be asked to suggest a problem that they see.
6.2 We have a group discussion on what they wrote and formulate together the general problem. e.g. How can we enhance connectivity / stability / decrease manual intervention in Kildevældssøen and ultimately in the park?



Activity

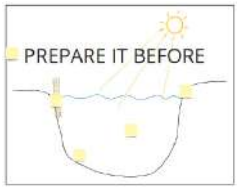
Board Development

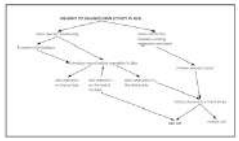
B.1 EXPLORING POSSIBILITIES 20min

1.1 Since the general problem refers to connectivity / stability, mention that we are working with ecosystem biomimicry (one of the many ways of biomimetics). Exemplify ecosystems that can be looked into, but conclude that in this workshop, we will only limit the biological solution to freshwater ecosystems and the ecosystems within it, also known as microhabitats.

1.2 We divide the participants into groups to discuss possible solutions based on what they've learned from Part A. We give them post-its on which to write their ideas, which they will afterwards present and put on the board image.

1.3 We reconvene and discuss each idea the groups present via Objective Tree. We add the solutions suggested in the Objective tree and at the same time discuss whether they can implemented (constraints). If nobody mentions floating vegetation, we suggest to add in the Objective Tree and explain again the microhabitats.





BREAK 10 min

B.2 FLOATING ISLANDS 10min

2.1 We present the more tangible biomimetic activity that we prepared for them, which has natural floating wetlands as a biological model (solution from nature) - explain what floating wetlands are and how do they function.

2.2 We show how the floating wetlands fit to the context - build up on the design constraints and state design principles extracted from the biological model needed to create own biomimetic floating islands.

Activity

Board Development

B.3 HANDS-ON 40min

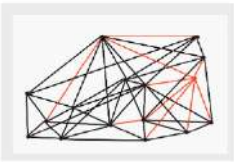
3.1 Present the mock-up of the floating island that we built to describe the layers of which it is composed while presenting all the potential materials that can be used and brought with us - we ask them how can it be improved?

3.2 Divide the participants in groups of 3 and distribute the equipment necessary to start the activity. Each facilitator will guide the participant groups.

3.4 Test the floating island in the lake.

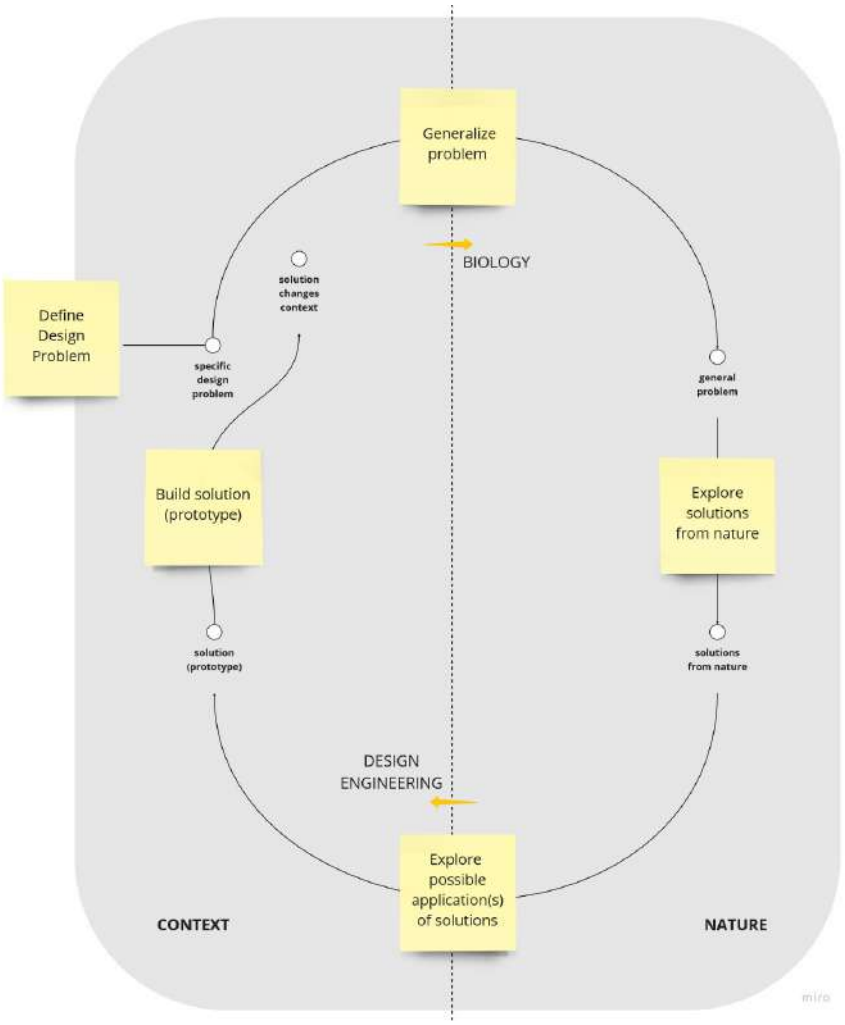
B.4 REFLECTION 10min

4.1 Reflect on the biomimetic outcome (floating island): Quick wrap-up: what did the prototype solve /did not solve in the bigger picture (looking back at the network and adding the floating island as a node(s) and exploring the new connections it creates).



4.2 Reflect on the workshop: learning experience / take-aways vs learning objectives presented in the beginning; feedback on workshop - written (pre-made questionnaire); mention that we might contact them in the next few weeks to have a follow up of the workshop

Figure 12: This figure is the simplified version of the circular biomimetic process presented in figure 11.



deeper implications of the human-made lake in Kildevældsparken and have them contribute in defining the general problem as well. In this way, together with the participants, we opened up the black-box of the natural setting before us, revealing the intricate complexities and interweaving dynamics of this life system, in which humans are a clear member.

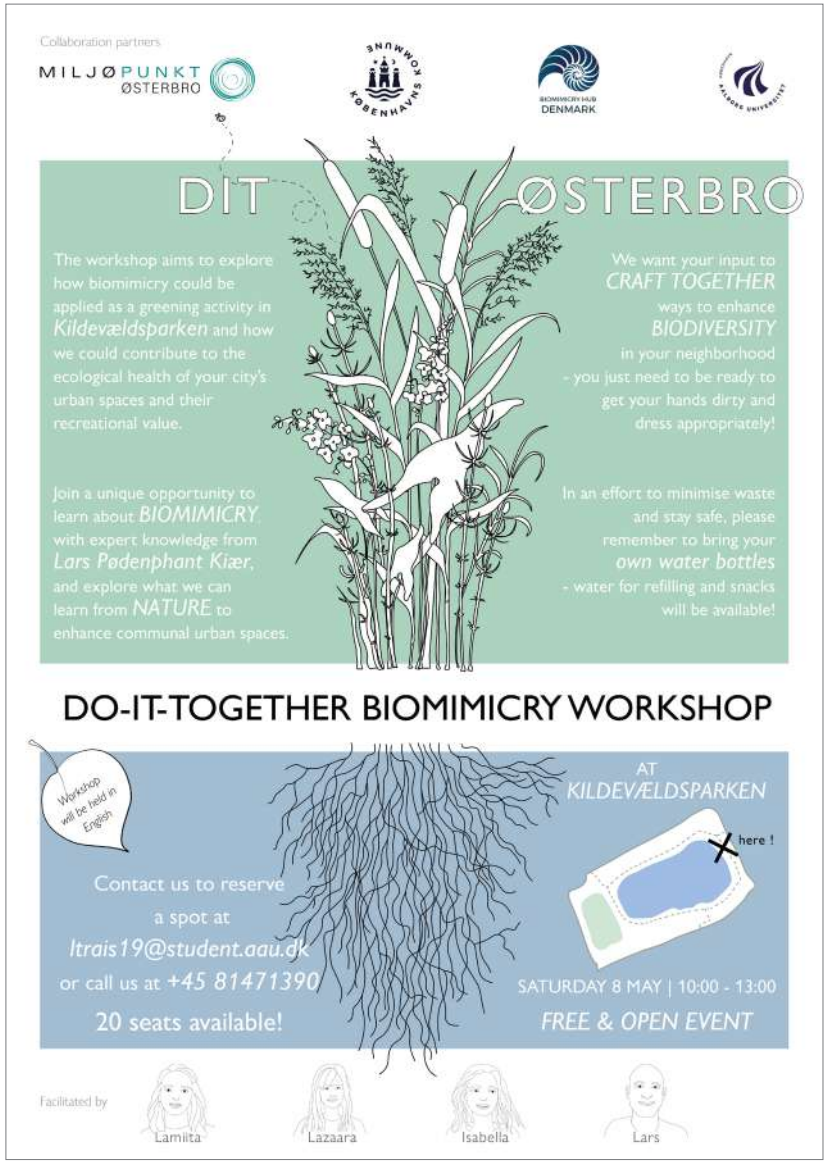
In order to set the participants' expectations, we presented in the beginning of the workshop a short list with the opportunities we wanted to offer them through the activities prepared. Since the workshop was not an instructional lesson, but rather an open space for participant collaboration and input, we presented this list as opportunities, rather than learning objectives. Participants were thus encouraged to have an impact on the outcome of the workshop and see it as an opportunity to discover the city's nature, biomimicry, and its application into a local context.

In the following pages, we present and analyse the workshop in all its features, looking into the invitation, leaflets, workshop activities, as well as materials and embodiments and their role in facilitating the design experiment.

invitation

Several weeks prior to the workshop, we crafted an invitation for the event – an integral step in staging as it plays a central role in framing "who is invited on the stage and what futures can be explored" (Munthe-Kaas and Hoffmann, 2020, p. 217). Our aim was to gather participants that were local residents of Østerbro (and ideally 'users' of the park) so that the exploration of their relations and interactions with the situated nature was experientially informed and meaningful. The target audience of the workshop was directed to adults. This decision was influenced by the structure of the workshop, the novel topic and the discussions we wanted to facilitate. Thus, we created an invitation in the form of a poster (shown on the right) that was digitally shared on groups based in Østerbro - platforms such as Facebook pages on Miljøpunkt Østerbro, Kultur Ø, Grønt Østerbro.[20]

The title of the invitation read "DIT Østerbro: Do-It-Together Biomimicry Workshop". Taking advantage of our multilingual context, we affected several meanings of 'DIT'. Our choice of 'DIT Østerbro' (meaning 'your Østerbro' in Danish) was intended to prompt intrigue of local residents by opening up the 'ownership' of the neighbourhood to participants. This can be seen as an element of what Munthe-Kaas and Hoffmann (2020) call choreographing 'stakeholderness'. Binder et al. (2015) fur-



[20] What we failed to consider, however, was placing physical copies of the invitation in the actual park – a thought that came to us the moment we stepped foot in the park on the morning of the workshop.

ther point out that the process of making an invitation requires a delicate balance between clarity and ambiguity. The invitation should be clear enough to intrigue participant curiosity, yet ambiguous enough to indicate an open space for participants' inputs and influence as well as a collaborative space for doing something new (ibid.). The second meaning of DIT, Do-It-Together, comes from a recent development to the Do-It-Yourself (DIY) movement that emphasises community learning and enhancement through co-creation (Dopazo, 2020) – a concept that is often mobilised in workshop formats. Hence, we used this term to reflect the active involvement of the participants in doing something new together (Munthe-Kaas and Hoffmann, 2017). The hands-on activity of building floating islands, however, was left out of the invitation (only visually alluded to by the drawing) to offer the participants a creative space for exploring possible solutions through a biomimetic lens.

In addition, we clearly stated our desire to use biomimicry as a greening activity yet left the term 'biomimicry' undefined to prompt intrigue and curiosity. The tension between ecological and recreational values, elucidated in our sensitivity discussion above, was also alluded to in the invitation. Nevertheless, space for the participants' articulation of the issue(s) was left open, since one of the main purposes of the workshop was to facilitate critical reflection on participants' relations and interactions with nature. And since this park is characterised by a quaint and peaceful atmosphere, we retrospectively noticed a window of opportunity that Kildevældsparken presented to us as an ideal setting for contemplation and reflection.

The local residents were not our only invited participants, however. We also invited Signe, Emilie, Lars and Sara to the workshop to act as participants, observers, or experts, by arranging an online meeting with everyone to discuss the workshop plan and their roles. Using our workshop plan as a loose script, we discussed their 'performances' with them to clearly outline their roles in the workshop and align expectations. For each activity, we made clear whether we wanted them to act as participants (i.e. engage in the discussions as local residents), as observers (i.e. pay attention to participant engagement, workshop organisation and any other details they deemed relevant), and as experts (i.e. provide useful knowledge for a given topic). However, as Dorland & Vinck point out, staging is "an overt and dynamic process which cannot be reduced to a script, plan or guiding ideas" (2020, p. 4). Thus, in the following sections, we further discuss the translation of our 'play', the staging and configuration of objects and the 'scenic' space in which the performances unfolded, as well an assessment of the design experiment based

on our three perspectives (biomimicry, urban greening, and sustainable design).

setting the stage

participant stage

Within the two weeks prior to the workshop, seven participants emailed us to reserve [21] a space in the workshop, all of whom showed up on the Saturday morning. As also outlined by Sanders (2020), "the place has a large impact on the success of the co-design session so it is important to visit the place ahead of time in order to be as prepared as possible" (Sanders, 2020, p. 59). Hence, we visited the park several times before the workshop to get a sense of the space in order to better inform and contextualise our staging considerations. Since the lake was a central component of the workshop content, we wanted to stage our experiment in view of the lake to make our discussions and reflections more tangible. Thus, we chose the barbeque area shown in the image on the right. It offered an ideal amount of space for sitting, moving around, and crafting. The view of the lake was ideal, in addition to the platform that allowed closer access and view of the water. On the day of the workshop, we arrived two hours before the start to set the

[21] We intended this step (participants contacting us to reserve a spot) to function as a kind of screening process in the event that too many participants were signing up as well as a way to gather insights regarding participants' interest in the workshop. However, only seven reached out and very few wrote more than their explicit desire to reserve a seat.

stage and assemble the human and non-human actors of our experiment.

As shown in the image on previous page, two tables were available for seating all of the participants (a total of ten participants, including Sara, Emilie, and Lars), which split them into two groups. To create a welcoming environment and in preparation for the unpredictable Danish forecast (wind, rain etc.), we assembled the participant tables. The following images illustrate the materials used in the set up along with brief considerations of our choices.

Papers, pens, and post-its were also placed on the participant tables to indicate the educational as well as generative aspects of the workshop.
Little rocks were also included as paperweights for the one participant that needed no invitation - Denmark's ever-blowing wind.

Seat covers, blankets, food and hand sanitizer were arranged on the tables in order to create a welcoming and safe environment for the participants. These objects also reflected an explicit presence of the experiment within the park - for bypassers as well as participants.

from bypassers to participants

Although our invited participants were clearly central performers around which we configured the scene, they were not the only actors setting foot on the stage. Given our on-site staging of the experiment, we also considered the human bypassers, walking through the park, as potential participants to enrol. We were thus able to take advantage of the public setting and loosen the boundaries set by the format of a workshop and our invitations, thereby also extending the scope for further possible mobilisation for the green network. This was done with the aid of human and non-human actors illustrated in the pictures below, that included posters [22], which were placed around the park and beside the participant tables, as well as leaflets, which were handed to bypassers, by Thomas, a friend comfortable with speaking both Danish and English.

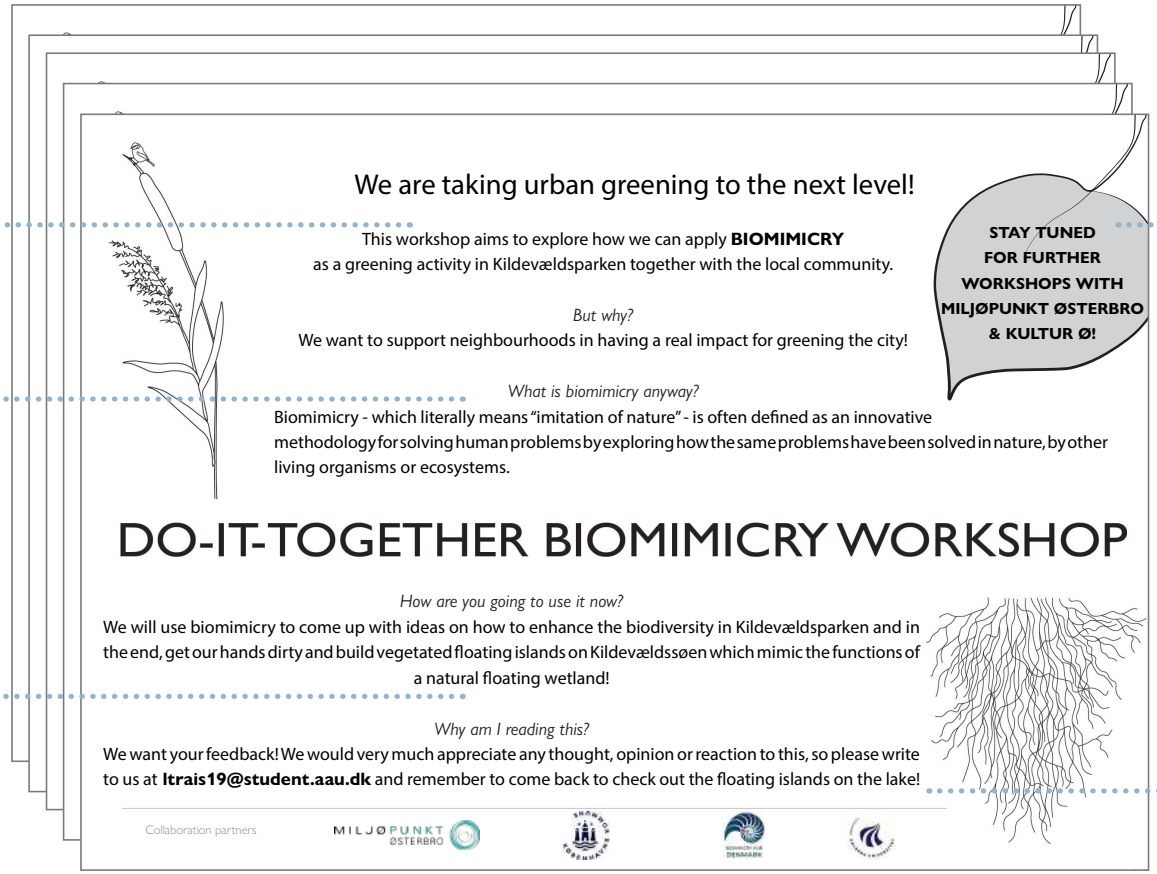
In order to more actively engage potentially interested bypassers, Thomas's role was to approach bypassers that paused with interest to observe the workshop performances and hand them leaflets that provided detailed information (in English and Danish) regarding the workshop and future possibilities. The leaflet was inspired by the invitation poster we digitally distributed so that it could be easier for people to link it to the event. Instead of leaving the leaflets on a table with a 'please take one' sign, we staged the leaflets as props for Thomas's performance to allow space for exchange between the workshop facilitators and the bypassers. In this way, we were able to gain insights from the bypassers with respect to their momentary impressions and perspectives on the workshop, urban greening activities, and the non-human life of the park. In addition, engaging in conversation with Thomas inscribed more meaning to the leaflets that the bypassers took with them, which thereby extended the impact of the encounter across space and time.

[22] The posters were large print-outs of the original invitation. This perhaps did not give bypassers enough context to understand the workshop, nor any direction for future possibilities. In retrospect, we should have used the content of the leaflets for these posters, as they gave more pertinent information to bypassers.

brief mention of the purpose of the activity to give bypasser quick introduction

rhetorical questions to intrigue passerby

floating islands were mentioned to interest readers and to show that urban greening can be done in multiple ways



We are taking urban greening to the next level!

This workshop aims to explore how we can apply **BIOMIMICRY** as a greening activity in Kildevældsparken together with the local community.

But why?

We want to support neighbourhoods in having a real impact for greening the city!

What is biomimicry anyway?

Biomimicry - which literally means "imitation of nature" - is often defined as an innovative methodology for solving human problems by exploring how the same problems have been solved in nature, by other living organisms or ecosystems.

STAY TUNED FOR FURTHER WORKSHOPS WITH MILJØPUNKT ØSTERBRO & KULTUR Ø!

DO-IT-TOGETHER BIOMIMICRY WORKSHOP

How are you going to use it now?

We will use biomimicry to come up with ideas on how to enhance the biodiversity in Kildevældsparken and in the end, get our hands dirty and build vegetated floating islands on Kildevældssøen which mimic the functions of a natural floating wetland!

Why am I reading this?

We want your feedback! We would very much appreciate any thought, opinion or reaction to this, so please write to us at **ltrais19@student.aau.dk** and remember to come back to check out the floating islands on the lake!

Collaboration partners

MILJØPUNKT ØSTERBRO

possibilities for future workshops left open and relevant for the green network

request for feedback and contact information gave a channel for post-workshop communication

facilitator stage

Finally, we staged our materials as workshop facilitators, which included materials for instruction, observation, documentation, and floating island construction. The images below illustrate these elements and our staging considerations.

We enrolled another actor, Jason, for the documenter's role to take photographs throughout the entire workshop. This not only benefited our purposes as researchers, observers, and students, but also provided material for Miljøpunkt Østerbro and Kultur Ø to share on their respective platforms during and after the workshop (which will be discussed further in the Mobilisation section). In addition, staging a photographer on the scene also contributed to the atmosphere by adding a sense of interest, engagement, and creativity. From the perspective of a bypasser, perhaps the performance of a photographer on the scene contributed a legitimising effect to the workshop. While, from the participant's perspective, being photographed perhaps contributed to a sense of collaboration and belonging. In any case, having the role of documentation extended to an external actor allowed us to focus on our role as facilitators, researchers, and designers. The table in Box 4 gives an overview of all the actors, their respective role(s) and 'props'.

Having set the stage, with sensitivity toward the socio-spatial context, the different roles and materials, we awaited our ten participants (seven local residents and our three collaborators) with mixed feelings of nerves, excitement and curiosity.

Box 4

HUMAN ACTORS	ROLES	NON-HUMAN ACTORS
Lamiita, Isabella, Lazaara	facilitator	script (synthesis plan)
	instructor	whiteboard
	observer	notepad + pen
	participant	nametag
Thomas	engage / inform bypassers	leaflets
Jason	document process	camera
Lars	biomimicry expert	circular process
	biologist/ ecologist	-
	participant	nametag
	observer	-
	facilitator	script
Sara	Miljøpunkt Rep.	-
	participant	nametag, ThinkBoxes
	observer	-
	facilitator	script
Emilie	Kultur Ø Rep.	-
	participant	nametag, ThinkBoxes
	observer	-
	facilitator	script
Allan, Felipe, Kasper, Ilka, Jullio, Nicola, Sophia	participant	nametag, ThinkBoxes, post-its

All materials for the workshop were printed in advance and arranged in order (based on the workshop plan) on a table, which we placed beside the BBQ, to use as prop for our facilitator roles.

We also equipped ourselves with notepads that included a copy of a synthesised version of the workshop plan so that we could keep track of the sequence of activities and the timing.
The notepad functioned as props for our 'observer' role so that we had space for taking notes.

Construction materials for the floating islands were placed out of view, since we wanted participants to explore possibilities before presenting the hands-on activity.

The display board served to keep visible all materials used in each step, so that they could be subsequently referenced when relevant.

WORKSHOP

PART A

GROUP 1	GROUP 2
Allan	Felipe
Emilie	Kasper
Ilka	Lars
Julio	Nicola
Sophia	Sara

A.1

ice-breaker

Our timely participants arrived at the scene. To break the ice and make participants feel comfortable, we set up small initial practicalities. We asked everyone to fill in their name on a piece of painter's tape and to place it visibility on their jacket, so that we could all get to know each other. After they took their seats, we began with an individual activity, which we presented as Think Box 1. The simplicity of the activity allowed the participants to quickly get involved without needing much guidance beyond what was written on the paper. So, we distributed the first ThinkBox asking them to describe in a sentence "what is a park?" and their opinion and experiences with Kildevældspaken (see picture on the next page with an example of ThinkBox#1- for further information, see Appendix 19).

Meanwhile we verbally asked the GDPR permission to take pictures during the whole activity: their reaction was very positive and appreciated us asking in advance. After presenting the workshop objectives, participants looked curious and excited to learn more from it. We planned to have a round of introduction, which we skipped and let naturally happen in between the activities. This perhaps made the experience of meeting each other a bit more organic because people were not aware of each others' various backgrounds during the workshop, stopping them from making assumptions on each other's knowledge and skills (i.e. leveling the playing field).

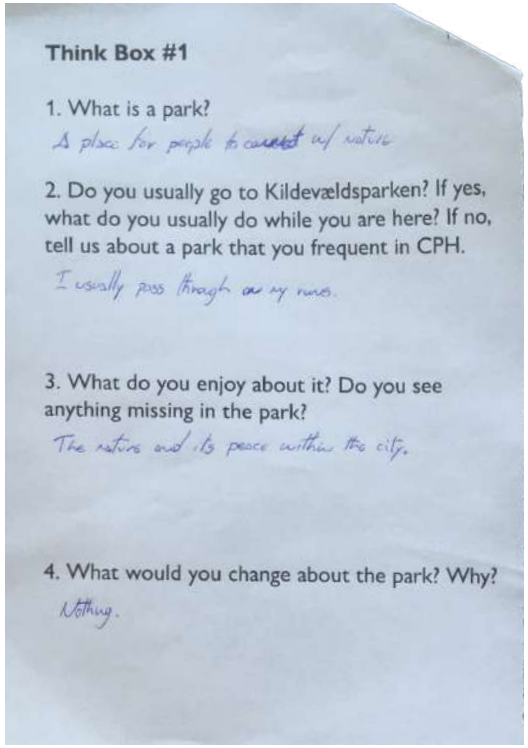
Although the Think Box questions did not explicitly ask about the lake, it was present in several responses, mainly in relation to its aesthetic contribution to the park (Sara, "it's a quality that there is a

Think Box 1 acted as an ice-breaker for starting the biomimetic process. By having participants reflecting on the park and their own experiences we took a holistic approach to making them 'see' the problem.

To ease the participants in the workshop, we began an individual activity: Think Box 1. The simplicity of the activity allowed participants to quickly get involved without needing guidance beyond what was written on the paper.

lake"; Kasper, "I like the lake"). One participant noted the lack of available opportunities to interact with the lake or other features in the park, "after surrounding the lake there is not much more to see/explore". Other problematizations followed a similar, human-focused perspective, such as the lack of trash bins and the amount and size of paths. Some bypassers, with whom Thomas spoke, also mentioned that they would like to see more trash bins in the park, as well as dog-waste bag dispensers.

Overall, we noticed through the descriptions that the park was related to recreational activities, positive feelings, sensory and extrasensory experiences. Given its peaceful atmosphere and small size, the park was perceived as an intimate space, a space for humans to connect with nature, to take a break from the city - similar to its characterisation in the development plans - parks as spaces of nature for humans.


Think Box #1

1. What is a park?
A place for people to connect w/ nature

2. Do you usually go to Kildevældsparken? If yes, what do you usually do while you are here? If no, tell us about a park that you frequent in CPH.
I usually pass through on my runs.

3. What do you enjoy about it? Do you see anything missing in the park?
The nature and its peace within the city.

4. What would you change about the park? Why?
Nothing.

THINK BOX #1

In ThinkBox#1, the main themes referred to parks and how humans relate to these green urban spaces. The responses followed a similar pattern, with few contrasting perspectives. The park was unequivocally described as a space that gives access to nature for city dwellers - an 'oasis' for humans to connect with nature in the city (Felipe, "a place for people to connect with nature…[I enjoy] the nature and its peace within the city"; Ilka, "a place..to connect with nature"; Julio, "A place to go when you want to go outside close to nature"; Sophia, "gives you a feeling of an oasis"; Lars, "a green oasis in the city"). One participant made a distinction regarding the nature found in parks, describing a park as "a place to walk among green and blue spaces of semi-nature".

Nevertheless, the connection to nature was characterised through sensory experiences like sounds, smells, sight, and movement (Allan, "the colours, the smell"; Sara, "I [1*] enjoy the sound of other creatures"; Allan, "as a place to walk, to make a run"), as well as extrasensory experiences like meditation and contemplation (Sophia, "to meditate"; Allan, "a place to relax"; Felipe, "it's nature and its peace within the city"; Ilka, "a place for contemplation"). The park was also characterised as a space for connecting with people (Sophia, "It's a place where all neighbours can enjoy different activities like walking, working out, picnics, enjoy nature"; Ilka, "a place to meet.")

The term 'biodiversity' was used as a synonym of the nature in the park (Sara, "is a piece of biodiversity in the city") or as a feature that is missing in the park (Allan, "more biodiversity"; Ilka, "I would enjoy if there was more to explore, more diversity"), as well as the need for wild nature (Sara [2*], "I would like for more areas in the Copenhagen parks to be "wild"; Lars, "more nature"; Ilka, "wilder!").

[1] The use of "I" reflected the parks' human purpose or the term "for", suggesting the parks functional characterisation. Analysing in-depth the terminology used by the participants would've been an exciting path to follow and explore.*
[2] Important to note here that although Sara was performing as a participant at this point of the workshop, her responses indicated a palpable organisational perspective and agenda.*

biomimicry

As a point of departure in the biomimetic journey we staged a group dialogue with the participants, by openly asking them *what is biomimicry?* Here, we employed the board as an empty space to prompt participant responses (see picture on the right). Participants had little background knowledge about the topic but shared relevant keywords which we simultaneously wrote down on the board, such as "mimicking nature", "design", "inspired by nature", "learning strategies by nature", "looking for solutions", "observation". This gave us an idea of the participants' familiarity with the concept.

Based on the discussion, we introduced Lars, who took the stage as the expert of the workshop, a role framed by the classroom-like staging of the tables and white board (see picture on the right). He briefly presented biomimicry and its general definition. As nearly all sources that we had come across in our research, Lars began his presentation with the fact that nature has been evolving on Earth for 3.8 billion years.

After this brief introduction, Lars described the circular biomimicry process that we visualised based on his suggestions in our previous meetings. To help participants run through the diagram, Lars used simple biomimicry examples such as Velcro (see Box 1) to discuss how humans have harnessed 'natural designs' to find solutions to human problems and how biological systems can be emulated at multiple levels (e.g. part of an organism, an organism or an entire ecosystem). He also directed the argument towards the biomimetic top-down (i.e. problem driven) approach by saying that biomimicry

is not only about gadgets to help humans by looking at nice functions but also about understanding societal problems and finding sustainable solutions.

lake intro

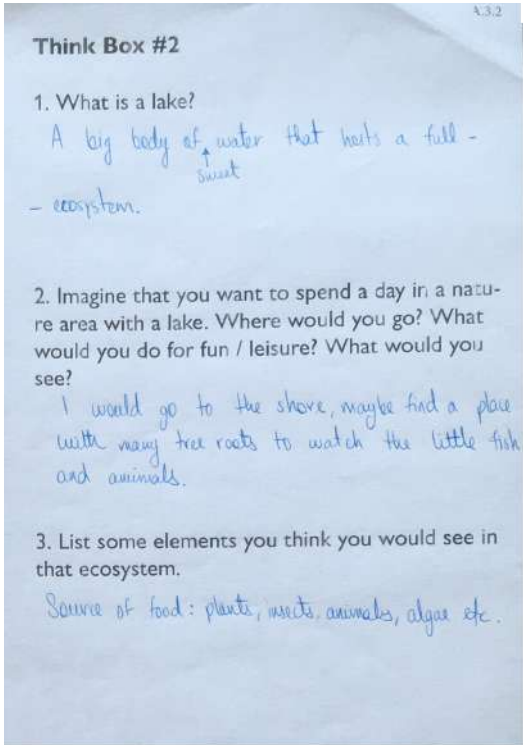
As presented by Lars, the first step of the problem-driven biomimetic process consisted of the identification of the design problem, which we staged as a series of generative and collaborative activities. Since the design problem was related to the natural system of an urban park, we approached it by first having participants reflect individually on what is a lake and what elements can be found in this ecosystem, as well as explore their own past experiences. We thus distributed the second Think Box (see picture on the next page with an example of ThinkBox#2 - for further information, see Appendix 19). Following, we asked them to "share the embodiments of their individual activities with one another" (Sanders 2020, p. 64), in order to begin opening the black-boxed term of a lake through a collective discussion. Although the conversations did not get going initially, we intervened by sharing our own experiences, acting as momentary participants to prompt discussions.

The individually generated responses followed a similar pattern in using objective, 'scientific' terminology (environment, ecosystem, microorganisms, reservoir) characterising a lake as an isolated object. The group discussions, however, elicited the participants' varying experiences and perspectives. In particular, in participant group 1, Emilie's memories of a lake were related to a scary situation she had when she was younger, contrasted to Allan's association of a lake to calm and peaceful experiences in nature. For Julio, on the other hand, lakes are often surrounded by residential areas, used for recreational activities, such as wakeboarding, paddle boarding, and sailing. Thus, we brought to light the contrasting perspectives surrounding

Having Lars as a participant in one of the groups intrigued the others to ask about biological facts about fresh water ecosystems.

Having the participants first individually generate responses in written form gave them something to reference during the discussions, which supported the conversations.

this natural element and how human interaction with it shapes the meanings around that element.



Think Box #2

1. What is a lake?

A big body of sweet water that hosts a full - ecosystem.

2. Imagine that you want to spend a day in a nature area with a lake. Where would you go? What would you do for fun / leisure? What would you see?

I would go to the shore, maybe find a place with many tree roots to watch the little fish and animals.

3. List some elements you think you would see in that ecosystem.

Source of food: plants, insects, animals, algae etc.

THINK BOX #2

In ThinkBox#2, the focus zoomed into one of the central elements of the park, namely the lake. At first glance, the participants situated the abstract idea of a lake in a "forest outside of Copenhagen" (Allan) or "a Swedish forest-lake where to swim" (Nicola), or in contrast in a place "surrounded by residential areas" (Julio). The lake was primarily described in more scientific terminology as "a big body of sweet water that hosts a full ecosystem" (Sophia), as a "natural water reservoir" (Nicola). Participants only mentioned activities only when asked, what would you do?. On one hand, people described actions surrounding the water: Sophia, "go to the shore", Allan " ride a bike or go for a walk with the family or a friend", Felipe "hike around [..] lookout for birds, trees, flowers and smell of the nature", Ilka "have a picnic with friends, enjoy the view". On the other hand, activities interacting with water were also mentioned: Julio, "kayak or paddleboarding", Ilka "possibly to swim", Emilie "canoeing".

Unlike the first Think Box, the second was followed by a discussion of the responses, during which participants started reflecting on the natural element of lakes in more detail and some with a particular focus on Kildevældssøen since we were situated in view of it. For example, Nicola began to wonder "if an artificial lake is still considered a lake", similarly Ilka questioned "where does the water come from for this lake?". Others discussed their past experiences with lakes in different countries, often in terms of recreational activities that interacted with the water, such as canoeing, paddleboarding or jet skiing. In response, one participant began reflecting on the impact some of these activities have on the surrounding life, noting that "we should also think about the lake as part of an ecosystem and how we are disrupting it". Overall, ThinkBox#2 highlighted the balance between what counts and what doesn't. Nature-oriented values started to arise along with human-centric ones.

lake sketch

This activity was framed as a design game that meant to set participants in a freshwater ecosystem from their own memories as the 'as-if-world'. We made participants enter this abstract universe of the game already through Think Box 2, but we also employed a visual drawing to focus everyone's attention on a single scenario to frame the collaborative activity. The drawing showed an average lake as a cross-section, which made visible the elements underneath the water's surface (see figure 13).

The first step of the game was to identify ecosystem elements and add new ones in the shape of drawings until a complete picture was made.

The drawing engaged the participants quickly as we asked them to note if there was anything missing with the hand-drawn quality of the visual reflecting our prompt for modification. The visual aid allowed participants to identify more elements of the ecosystem than they had initially written down in their ThinkBox 2 entries. So, participants started pointing out missing elements (humans, trash bins, microorganisms, rubbish, such as a bike at the bottom of the lake, rain, bats, insects), which we promptly added into the drawing. By staging the drawing as a collaborative activity, we were able to establish a co-creative atmosphere in which there were no requirements for expert knowledge or experience.

The next step of the game was to 'connect the dots' based on the different relationships between elements that make up the ecosys-

Using tracing paper, we were able to map out the relations between the elements, without marking the original drawing but still keeping it visible.

Figure 13: Drawing of lake cross-section.

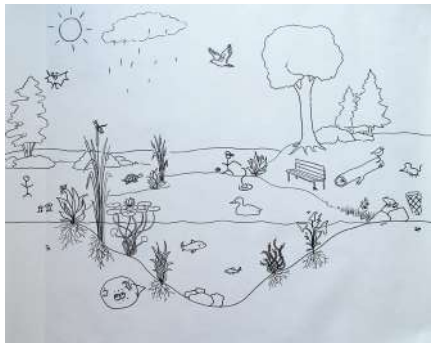
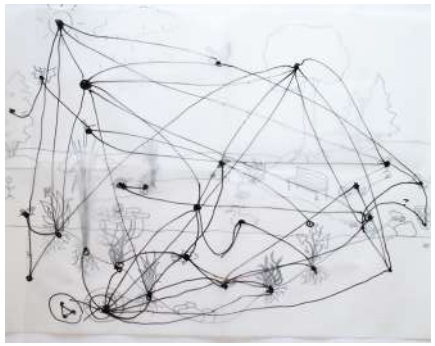


Figure 14: Mapping relations.



tem. In order to introduce the participants to this part of the activity, we referred to a ThinkBox2 discussion we observed, in which a participant brought up the consequences of human recreation to the non-human life in and around the setting and the need to think about lakes as entire ecosystems. Thus, we asked them, what does it mean to think about something as a system? A participant responded, to look at the connections. Thus, we began collectively exploring and mapping the relations between the elements in the drawing (figure 14), in an effort to uncover the high level of connectivity and complexity of an ecosystem, while taking a particular focus on the nutrients cycle, as this was ultimately the focus of the biomimetic intervention, and simple enough for everyone to understand in terms of food.

The participants seemed intrigued, with all of them contributing when prompted by guiding questions, such as what does the hawk eat? It seemed that the participants came with an understanding of biodiversity and its importance, but when they were asked to identify what certain animals depend on (in terms of nutrients) the answers were often related to what humans give animals to eat ("what does the mouse eat?", "the mouse eats trash", "the mouse eats cheese"; likewise "what do fish eat?", "fish food"). As anticipated, the drawing became a co-produced entangled mess of connections and relations central to the visualised freshwater ecosystem.

At this point, Lars noted that looking at the connections in terms of nutrients is only one of many other ways to map out ecological relations, "We could take another layer of tracing paper and think about these connections in terms of species diversity and micro-habitats, how species help each other, not only eating one another." Although we had planned a segment here where Lars would delve into these other connections, we reached an unspoken decision to move on in the interest of saving time. Noting that we had clearly not exhausted the list of relations, but had perhaps exhausted ourselves in trying to do so, we gave participants a ten minute break.

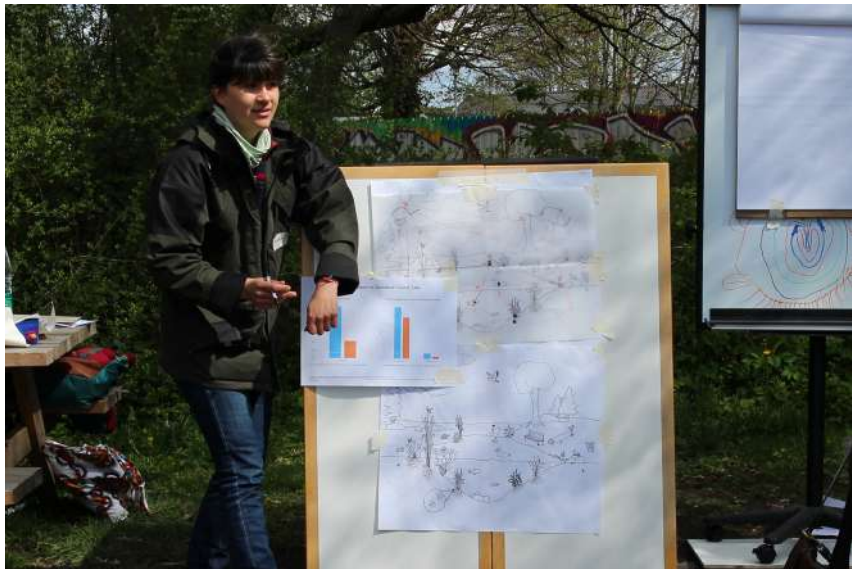
spot the differences

After ten minutes, we reunited the participants to take their seats. We introduced the 'spot the differences' activity relating it to "the fun game which often appears in newspapers" that includes two images that at first sight seem similar, but differ in small details, whose discovery encompasses the aim of the game. The objective was to get participants to 'see' the problem of the lack of connectivity in Kildevældsparken, by having them compare the drawing of our abstract freshwater ecosystem world with the setting of the park.

Before starting, we shared with the participants a brief history of the park (e.g. when the park was built, how the lake was formed, its depth, the role of the fountain, etc.) to give them a more detailed understanding of the historical and cultural context of the park. Here, Emilie shared the legend of the train tracks inside the lake, where it was believed that remnants of an old railway system were hidden underneath the water's surface.

We divided the participants into four groups and distributed to each the natural lake drawing (see figure 13), inviting them to spot the differences between the image and the park in which they were standing. The participants had the option to have a walk around the dock and the park itself to have a closer look at the surrounding elements.

During this activity, Emilie and Sara no longer took on the role as participants, while Lars facilitated group conversations as an expert biologist/ecologist. We performed as observers, taking note of the group conversations. We noticed that the role of the municipality



A.5

The on-site setting offered plenty of "spaces for sitting, working, playing and moving" (Sanders, 2020). We invited participants to walk around the park and discuss in groups. This was materially aided by smaller copies of the ecosystem drawing mounted on a clipboard to support on-the-go writing.

During a ten minute break, some of the conversations shared positive first impressions of the workshop so far.

was brought up several times by participants regarding the maintenance of the park. The drawing of the ecosystem included a dead log on the ground, which a participant crossed out on the paper, saying that, to her knowledge, the municipality takes away dead trees and branches.

This activity reinforced participants' arguments and understanding of the topic, making them feel more confident and aware of the workshop's topic. It seemed to be a very natural and fun activity to stage.

When the participants reconvened, we asked them to share their observations. For each note, we prompted discussions regarding the ways in which the observed differences affected the relations in the ecosystem (referring to the network drawing we made together), thereby translating the observations into problematic relations existing in the park and highlighting specific issues supported by scientific data. While the participants shared their observations, we simultaneously marked them on the drawing, showing how the system slowly started to fall apart, creating or destroying nodes within the network and their respective relations. An important observation - we further considered - was that being on-site allowed participants to raise topics (e.g. "oh and the fountain - that's new! [..] it doesn't [do much] in the middle", Sophia) we wanted to discuss with them, without having to introduce them ourselves, making the discussion more relevant and tangible.

There was a clear identification of the lack of vegetation and aquatic plant diversity as well as the wooden banks around the lake. In order to illustrate the consequences of the spotted differences beyond the markings on the network (which was a bit confusing to keep track of), we prepared simple bar graphs that compared nutrient and chlorophyll levels of Kildevældssøen vs. an average healthy lake (based on European standards.). Participants reacted with interest and heightened attention. The clear mathematical translation of our discussions proved to be impactful - paralleling growing debates surrounding the role of metrics, statistics, and data in sustainability transitions (Paris21, 2018).

generalise the problem

Referring to the biomimetic process introduced by Lars in the beginning, we showed the participants that we had reached the step of needing to re-frame the problem identified in the park.

Presenting this activity as a third (and final) Think Box allowed participants to individually generalise the problem, which we then discussed together as a group. (see picture on the next page with an example of ThinkBox#3 - for further information, see Appendix 19) with the aim to make them reflect on the issues they identified so far. We invited them to share their thoughts: there seemed to be a higher understanding on the role of design in an urban park, of human control and of nature in cities (e.g. Sara mentioned the problem of rethinking the way we design city parks and provide space for more species; Kasper outlined that "[..]there should be more thought into design and building parks in regards to nature in order to sustain healthy and functioning ecosystems").

The lake was identified as a problem due to its purely human-centred, aesthetic role - "the lake is not a lake"; "the lake is just an accessory" - compared to a 'real lake' that functions as part of a bigger system, connected to many elements. The discussions also pointed to a clear tension between the human presence in the park with the ecological conditions of the ecosystem. Bringing up maintenance as an example of this tension, participants discussed the extent to which a park needed to be kept tidy for human purposes or left alone for nature to flourish on its own. Here, a participant noted that we must consider, "what do we really need?", bringing forward

A.6

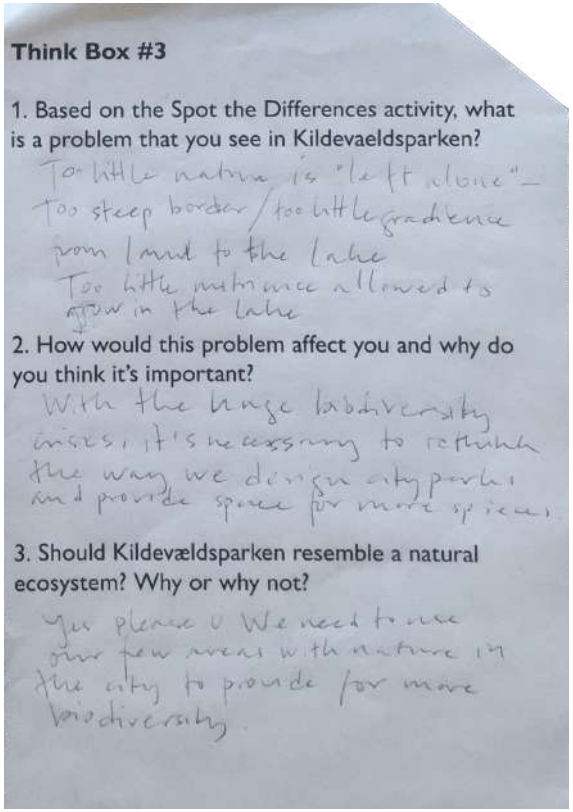
As part of the process for generalizing the problem in Kildevældsparken, participants had to reflect individually in another Think Box exercise.

Presenting this activity as a third Think Box allowed participants to individually generalise the problem, which we then discussed together as a group. Here the Think Box papers acted as extensions to our researchers role, so that we were able to focus on our role as facilitators while simultaneously gathering insights on the participants' understanding and interpretation of the activities in written form.

A single general problem was difficult to establish as participants had very different inputs. We could identify two main themes such as: low connectivity between ecosystem elements and issues in balancing the recreational and biological values of the park.

considerations reminiscent of 'biosynergy' that call for the need to design from within nature's mindset by asking ourselves: "What should we want? What does the rest of nature want us to want?" (Mathews, 2011, p. 14).

The conversation was thus moving in interesting directions, and in the future we would consider to lengthen this segment of the workshop as it offered space for new articulations of these issues. However, given our time constraints, we had to move on at this point. Although the problem did not get explicitly formulated as a generalized problem, the issues regarding the lack of connectivity between the elements that made up Kildevældsparken as well as the need to reconcile the tensions discussed above were clear outcomes of this activity.


Think Box #3

1. Based on the Spot the Differences activity, what is a problem that you see in Kildevaeldsparken?

Too little nature is "left alone" – Too steep border / too little gradience from land to the lake. Too little nutrience allowed to grow in the lake

2. How would this problem affect you and why do you think it's important?

With the huge biodiversity crises, it's necessary to rethink the way we design city parks and provide space for more species.

3. Should Kildevældsparken resemble a natural ecosystem? Why or why not?

Yes please ☺ We need to use our few areas with nature in the city to provide for more biodiversity.

THINK BOX #3

In ThinkBox#3, the aim was to help participants come closer to the general problem being discussed in the workshop. Many issues were being identified - the dominating human-centred values of parks (especially in terms of aesthetics), the lake's semi-natural condition, human presence.

Many reflections arose in response to the biomimetic approach and the brief biological knowledge shared and collaboratively discussed and explored. For example, the lack of species and biodiversity became visible to all: Nicola "plants missing", Sara "biodiversity crisis", Felipe "provide better living spots for life of other organisms", Kasper "lack of animal life", Ilka "no vegetation". Based on these considerations, participants started to honestly believe in the need "to support biodiversity" (Ilka) and the general need for a change regarding the natural conditions present in Kildevældparken: "why to have a lake when it's not bringing anything good to the surroundings and nature" (Nicola).

As in Think Box#2, participants realised how human presence is so dominant in natural areas, as suggested by Felipe, how "humans need more contact with nature". If people don't interact with nature, "[the park] will keep being affected with time, so it won't be a nice place to hang out" (Sophia). What made the participants question themself throughout this exercise was answering "what do we really need?" (Sophia), "what is our point of view?". It sparkled in them the awareness of "too little nature is [being] left alone" (Sara), where parks like Kildevældsparken are designed "for human activities much less for nature" (Allan), thus causing problematic "human interference that affect[s] the park" (Julio).

Natures' problems thus became relevant to our human participants. "For us to live, we need the other elements in the biodiversity-ecosystem" (Emilie). Thus, the exploration and cultivation of synergistic human-nature relations, by which humans can enjoy nature but also have a positive generative impact came to light - Sophia, "it's a way to give back to nature after the damage we have caused", Allan "I would like to make a change of the park. Feels like it's the right thing to do ". Thus, the evident tension between the human realm and the natural ecosystem, as observed within the park's development plans and our other sensitivity analyses, took center stage in participants' articulations of the problem as well; thereby challenging participants' initial problematizations that centred around a 'nature for humans' conception.

WORKSHOP

PART B

GROUP 1	GROUP 2
Allan	Felipe
Emilie	Kasper
Ilka	Lars
Julio	Nicola
Sophia	Sara

Moving on from the problematisation space, part B of the workshop aimed to follow the bottom half of the biomimetic process, by which we opened up a solution space for the participants to explore and intervene together.

exploring possibilities

Given the general problem - based on freshwater ecosystems and how they can have enhanced connectivity between its elements - we re-introduced ecosystem biomimicry as an approach to mimicking nature. Given the limited time of the workshop as well as our thorough discussions of freshwater ecosystems in part A, we truncated the research phase as defined by the biomimetic process and opened up the solution space. Here, we presented an Ideas Template that was a simple visualisation of the cross section of Kildevældsparken on large poster paper (see figure 15).

As indicated by the large amount of empty space on the drawing, participants were asked to think of and add (via post-its) possible improvements to Kildevældsparken. We used the display board to keep the visual elements of part A visible, so that participants could reference this content during their solution-oriented explorations (picture on the right).

Keeping the participants divided in their respective groups, we distributed post-its for them to note down their collaborative ideas, specifying that there were no right or wrong ideas, and that this content would be subsequently shared with our contact with the

B.1

In the process of exploring solutions from nature that can be used as biological models, participants had to brainstorm in groups based on the knowledge on freshwater ecosystems gathered from previous activities.

The biological solutions proposed by participants were more in the form of elements that could be added or removed to enhance the level of connectivity in the park's ecosystem. They did not manage to make abstraction of the physical environment and think of natural phenomena that can be used as inspiration.

Participant presentation was facilitated by the use of sticky notes that they filled out with ideas as groups and then brought up to add to the board.

park administrator. This was said in an effort to show the participants that we are offering them an open channel to have their voices heard (which was also reflected in the presence of Emilie and Sara).

We circled around the groups, listening to the conversations, after which each group shared and attached the ideas onto the board (see picture below - with a close-up). At this point, Emilie, Lars and Sara switched their roles from participants to facilitators since they were aware of the floating islands idea. Thus, they gave space to the other participants to explore solutions themselves, while still partaking in the conversations by asking questions and prompting participants to elaborate on their ideas.

Both groups explored different ways to introduce more vegetation in and around the lake, including ideas similar to the floating islands model. The removal of the wooden banks was also deliberated by both groups, referencing content from part A about gradients and micro-habitats. Group 2 specified the need to move the paths surrounding the lake, in order to make more space for the lake to expand and form sloping banks. Since participants seemed to be aligned and ahead with visualizing the next steps of the workshop, we skipped the Objective Tree that we had prepared as part of this activity. We took advantage of their agreement that a biological model should seek to include more vegetation in Kildevældssøen to introduce the hands-on activity, highlighting that we wanted to make something with them in the remaining time that we had.

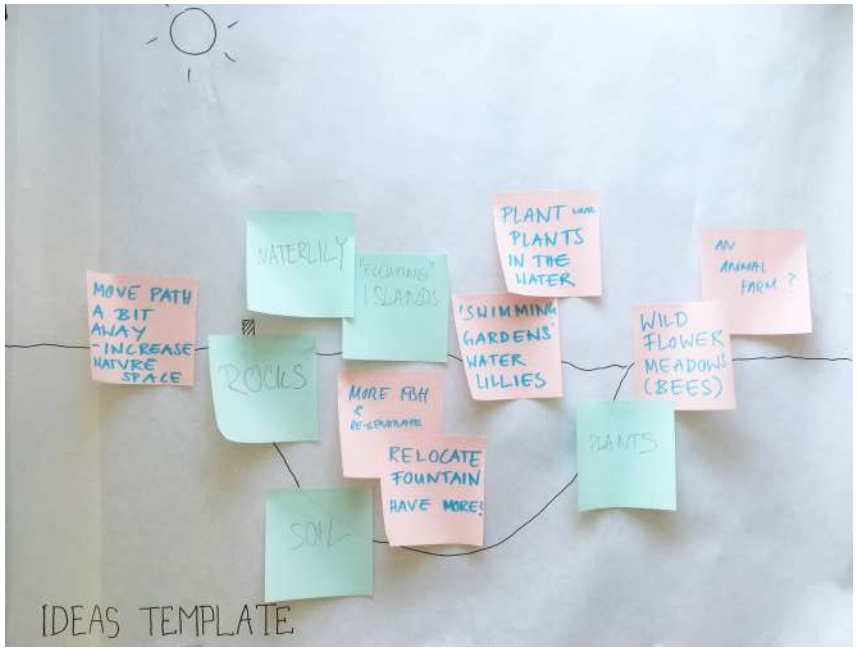


Figure 15: Ideas template.

B.2

floating islands

Here we presented the biomimetic solution by illustrating the concept of floating islands, how they function and the biological model they mimic. Passing around visual examples, we presented the different variations and interpretations of floating islands that have been made and installed around the world. Here we highlighted the choice of materials - with nearly all examples using plastic as the main component of the floating island bed. Participants were intrigued, contesting the use of plastic as they passed the printed images around.

We presented the biological solution that we researched prior to the workshop - the floating islands - by mentioning the functions abstracted that are relevant to the general problem of low connectivity in the ecosystem, as well as design principles extracted to be able to build prototypes.

Showing the prototype together with the exploded illustration of the floating islands encouraged participants to apply the principles presented and implement design solutions.

Our prototype sparked palpable interest with participants willing to begin the hands-on activity without further instruction.

hands-on

To better get the idea of what we were talking about, we showed our prototype made prior to the workshop. It was built to describe the layers integral to its design and to present the available materials (see pictures on page 63 with the prototype and materials) that we started slowly taking out and placing in between both tables. The excitement was palpable as participants began standing up and interacting with the materials. We explicitly invited them to redesign and improve our prototype, while highlighting the importance of following the layers presented in the exploded visualisation that each group was given. Immediately, a participant from group 1 reacted "let's make a circle one!" as she approached the materials.

The two groups approached the activity in a different way: group 1 actively experimented with the shape and the layout of the materials; while group 2 instead followed the model of the prototype. Here, we divided ourselves among the two groups with one of us joining group 1 and the other two group 2 (although we did not plan this, nor explicitly discussed it at the workshop, this division was helpful as Emilie, Lars, and Sara were not able to stay past the planned end-time and Nicola had to leave early).

In group 1, one of us suggested dividing the group efforts based on the layers in an effort to accelerate the process of making the island as we noticed the group members were hesitant in beginning the process. Julio and Allan started working on the structure, while Emilie, Ilka and Sophia worked on the coconut coir substrate layer. Julio and Allan began arranging the long bamboo sticks in a pentagonal shape, which Julio drew on a post-it note in an effort to communicate his idea to Allan (pictures shown on the right). His idea came from a book he had read about how to survive on a desert island, which recommended building a raft in this form.

When this structure was built, the next step, as visualised in the exploded image, was to create a net-like structure in the centre that would subsequently hold the bamboo leaves. Here, Allan began arranging the tree cuttings in an asterisk-like shape, as shown in picture below, presenting his idea to the group to mimic the shape of a spider's web for this layer. We were excited to observe the ways in which the biomimetic process unfolded in new directions, with the participants having the materials to think with and translate their own biomimetic approaches to the prototyping process.

In the meantime, Ilka and Sophia worked on the substrate, which they formed using the rolls of coconut coir we had provided. Due to the shape of the rolls - long and flat rectangular pieces - they decided to make a kind of pillow shape for the substrate, using the smaller coconut pieces as filling.

Meanwhile, group 2 was motivated to make the island quicker due to timing, following the same shape and layers of the prototype we proposed. We noticed that the group (which decreased in number as two of the participants had to leave early) wanted to use the least amount of manual work. For example, they were experimenting with ways to weave the bamboo sticks together without using strings to bind them, but rather trying to take advantage of the inherent physical forces present in the structure of the base.

Based on our observation, it seemed that both groups felt like they had the freedom to re-design our initial prototype. It appeared that they took the part of 'experts' for building the islands, feeling empowered by our presentation and earlier collaborative deliberations and activities to tackle this task together. Perhaps our prototype's unrefined look gave the participants confidence to modify the design and take the lead during the hands-on activity.

As soon as each group finished the islands, we deliberated together as an entire group how to best attach the anchoring rocks and rope to the islands. Subsequently, having previously applied for and received permission to place the islands in the lake from Vand og VVM (Københavns Kommune, n.d.-b), each group carried their islands toward the edge of the lake. Approaching the lake in a processual kind of formation (image on the right), we commented that the moment felt like a religious experience, to which the participants laughed in agreement, with one noting that she was thinking the same thing. This feeling could perhaps be explained by the fact that we worked together on something greater than ourselves - on something that was not directly for our own, human benefit, but for nature, for the natural world, to which we belong as one community.

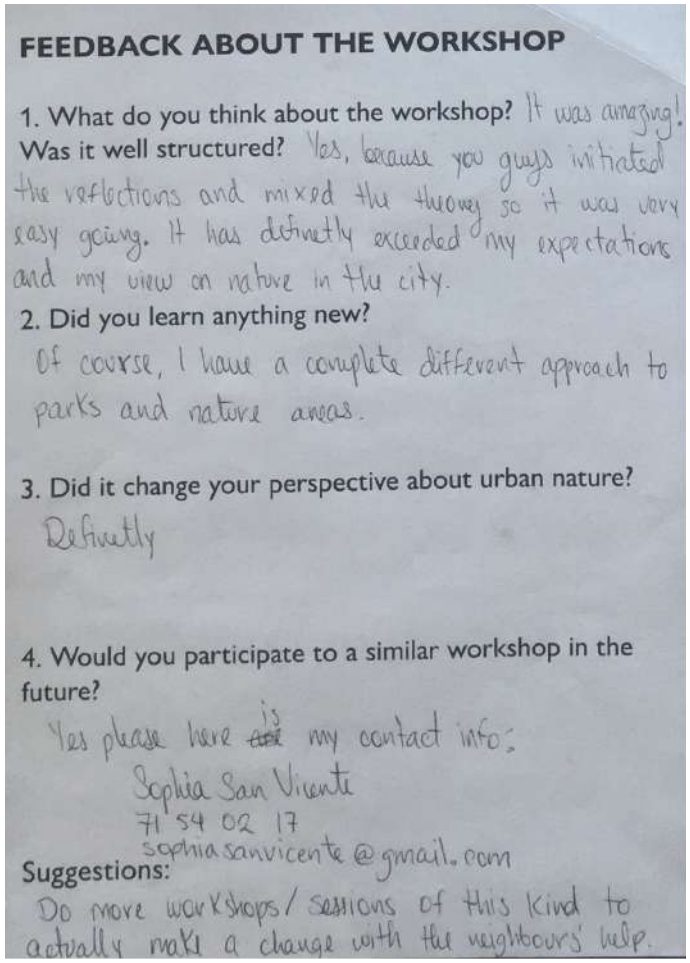
Each group carefully placed the islands in the lake, with everyone observing with both excitement and nerves. To everyone's delight, the islands floated! We assembled to form a group picture (below), making sure the islands were visible in the background - a testament to our collective efforts.

From pages 108 until 112 we present the workshop storyline in a series of photos.

reflection

Since the workshop lasted an hour more than what we expected, we didn't have the time to reflect together with the participants as we had planned. So we handed them the feedback sheets (see picture on the right with an example of Feedback sheet - for further information, see Appendix 19) we had prepared, giving them the option to email [23] us their responses should they want to leave. The majority stayed to write down their feedback and left thanking us for the insightful and fun workshop.

After the participants left, we stayed in order to clean up. Noticing the amount of leftover materials, we decided to fortify our initial prototype and install it in the lake as the third and final floating island - a testament to our project and student efforts. We finished the third island, carefully placed it in the lake and had lunch in the park. As we ate, several bypassers noticed the islands in the water and approached us with questions.



FEEDBACK ABOUT THE WORKSHOP

1. What do you think about the workshop? It was amazing! **Was it well structured?** Yes, because you guys initiated the reflections and mixed the throws so it was very easy going. It has definetly exceeded my expectations and my view on nature in the city.

2. Did you learn anything new?

Of course, I have a complete different approach to parks and nature areas.

3. Did it change your perspective about urban nature?

Definetly

4. Would you participate to a similar workshop in the future?

Yes please here is my contact info:

Sophia San Vicente
71 54 02 17
sophiasanvicente@gmail.com

Suggestions:

Do more workshops / sessions of this kind to actually make a change with the neighbours' help.

[23] We noticed that the feedback received by email was way more structured and detailed than the written ones.

workshop storyline | A

A.1

A.3

A.5


A.2


A.4


A.6

B.1

Group 1

B.3

Group 2

B.2












mobilisation

Mobilization has been done continuously throughout the project, based on the existing relations in the context which we analyzed in sensitivity and the staging of the design experiment aimed at identifying what it could be. The mobilisation process was two-fold throughout this project. On one hand, the design experiment helped mobilise actors in the green network. We, as designers, took the role of navigators, with the hope that Kultur Ø and Miljøpunkt Østerbro would take over and develop their role as urban greening actors to further mobilise the green network in the future. On the other hand, biomimicry can be regarded as a network in itself, where we managed to shift existing relations, but also added new ones in the effort of translating it into urban greening activities.

mobilising the green network

The green network is in its early stages, and thus the process of mobilisation is still ongoing. However, we could see how the green network slowly developed as part of this project and how some existing relations between actors strengthened, as well as new ones were formed. For instance, the relationship between the Park Administrator of Kildevældsparken and our collaborators, Kultur Ø and Miljøpunkt Østerbro, developed during our sensitivity analysis of the physical context. It turned out that Signe shared similar values and concerns as our collaborators, in particular the challenge of creating a balance between "[..] leaving nature alone and the wish to be close to it" (Signe - See Appendix 14). This made her want to contribute and be part of the project, which was a great support in mobilising the green network as she is a key actor in the municipality who is able to negotiate permissions for urban greening activities.

> *[..] I think it's worth it to use time on [this project]. So I would like to participate in this and it would be great if we could do some small 'one time thing' in the park because this involves people getting them regularly to do something about the work we could do.*
> (Signe - See Appendix 14)

Furthermore, by sharing various visualisations of our sensitivity analysis with our collaborators, we managed to bring them

closer together and facilitated the momentum for creating a synergy of agendas that could be used as a foundation for the green network.

At the same time, our empirical material about Kildevældsparken was employed in our discussions with both our collaborators and our participants in the design experiment in order to shift relations in the network with non-human actors of the park.

> *I didn't knew that that was so important and for me it was just a lake.*
> (Emilie - See Appendix 22).

Thus, by opening Kildevældsparken as a matter of concern during the design experiment, human-nature relations were challenged, which ultimately mobilised non-human actors to be regarded as part of the green network, instead of just elements setting the stage for urban greening activities.

Another key actor that was mobilised through the design experiment is the local community in Østerbro. Direct participants in the workshop exchanged phone numbers while some of them became part of the Facebook group dedicated to the green network. The leaflets shared to by-passers through Kildevældsparken resulted in citizens passing by the workshop to hear more, getting curious in seeing the floating islands, as well as reaching out to us by email to show interest in future initiatives ("Tell me if I can in any way be helpful with other initiatives!" - Mads, translated from Danish - See Appendix 19). Having the permission to place the floating islands in the lake after the workshop also interested the by-passers, who reached out to us to ask the story behind them while still in the park. They were pleasantly surprised when we told them that they enhance biodiversity in the park - and many took pictures of the lake pointing to the floating islands or went closer to where we anchored them.

The floating islands as well as articles on social media had a great impact in creating awareness and getting citizens interested in future urban greening activities. Shortly after the design experiment, Miljøpunkt Østerbro as well as Kultur Ø shared pictures from the workshop on their Facebook pages (see picture - SoMe image). This was followed by an article on Miljøpunkt Østerbro webpage (Miljøpunkt Østerbro, 2021) as well as a story in Østerbo's local newspaper (Østerbroliv.dk., 2021). Both articles mention the floating islands in their title as a way to get readers interested, while stressing their benefits for biodiversity. Biomimicry is also used here as an interessment device to highlight that together with our collaborators we engaged citizens in something

new, but without giving too many details on what it actually means. In addition, in both cases it is mentioned that Kultur Ø and Miljøpunkt Østerbro will be engaged in future interventions that will have a focus on local biodiversity, thus opening up the opportunities for further mobilisation of the green network.

mobilising biomimicry as part of the green network

In terms of biomimicry mobilisation, we noticed how the concept evolved throughout our sensitivity analysis. Its sustainability promises acted first as an interessment device, after which we managed to open it up as a network and shift its relations in order to be translated into urban greening activities. In this process, our collaborators, Kultur Ø in particular, were the first to be mobilised, who in turn started spreading the word to other urban greening actors:

> *These projects could be seen as steps for citizens to educate themselves and see nature in the city in a different/new way [..] I haven't looked at this ever before and for me it is wow, a new way of thinking.*
> (Emilie - See Appendix 17)

> *I was actually at this seminar the other day about urban greening and they were asking for ideas of activities and I actually suggested biomimicry and started explaining it - I felt so clever!*
> (Emilie - See Appendix 19)

In addition, biomimicry became an actor that challenged our collaborators' conceptualisation of urban greening activities and made them reflect on ways of moving beyond the outcome orientation, and see urban greening more as an explorative process towards a more dynamic understanding of nature:

> *And it's just nice to start up in an environment and a community of green thinking with this idea, because it really help(s) us thinking: how can we think in green projects? I really like it.*
> (Emilie - See Appendix 22)

Through our effort in establishing new relations between the two networks of biomimicry and urban greening context, additional actors were mobilised, such as Lars, our expert in the design experiment, who opened the opportunity of further mobilising actors from Biomimicry Hub Denmark as well as Nordic Biomimicry in future experiments.

However, additional steps need to be taken in order to reach a mobilisation of the two networks. A first step would be to support Kultur Ø and Miljøpunkt Østerbro to further develop their role as navigators. After staging the design experiment it became clear from the feedback that they are not ready to take on this role yet:

> *We will help, but we also need to figure out how to make the relationships between citizens and the floating islands. Maybe the workshop participants would like to take charge in continuing this kind of workshop.*
> (Emilie - See Appendix 19)

> *Next people doing this would need the same communication and organization skills like you.*
> (Sara - See Appendix 19)

In order to mobilise them more, Kultur Ø and Miljøpunkt Østerbro could have been included to a greater extent in the process of co-creating the design experiment that we staged. Due to time constraints, we took the process of designing the intervention mostly on us and only asked them for input and feedback. Thus, the design experiment should be followed up with other interventions where actors mobilized so far could develop their role as navigators and slowly become comfortable with biomimicry as part of urban greening activities.

Overall, the design experiment managed to support both the mobilisation of the network in the making of urban greening in the local context and the expansion of the network around biomimicry. Future interventions will give the possibility of strengthening the new relations established and continue building the momentum for employing biomimicry within urban greening activities.

assessing the workshop

biomimicry perspective

The problem driven biomimetic process (see figure 11) was helpful in structuring the workshop activities. However, in practice, the process was more iterative, not as straightforward as the visualisation of the steps implies. This was due to our first and second principles of having positive feedback loops between humans and nature and working with people. While advancing through the biomimetic process, the activities introduced were focused also on exploring synergistic human-nature relations and interactions, while making citizens reflect on the overall questions for each phase.

During the problem definition for instance, the workshop activities were guided by the question "What are some sustainability challenges related to the human-nature relations of the context?". This made the workshop discussions fluctuate between the nature and context realms multiple times, instead of keeping our focus solely on the context. For example, through activities A.3 and A.4 (Lake intro and drawing) we already introduced participants into nature's realm, in order for them to be able to compare generic freshwater ecosystems with the man-made aquatic environment in Kildevældsparken within the next activity (A.5 - Spot the differences). Furthermore, this fluctuation between the realms meant to also give participants biological knowledge in order to be able to look for biological solutions in Part B, since we were on-site, without access to computers and within a limited time frame.

The problem however did not get fully defined upon this process in activity A.6, because the previous discussions made participants think of both problematic human-nature relations in the context and specific issues in the ecosystem. In the next activities, we chose to focus our attention more on the specific issues in the ecosystem, so that participants could actually think in biomimetic terms of biological solutions that would be able to solve the problem 'here and now'. We thus reframed the problem as "How can we enhance connectivity between ecosystem elements in Kildevældsparken", while pointing to sub-functions such as "removing nutrients", "enhancing biodiversity", that we also previously discussed during the problem definition phase.

While exploring solutions from nature in Part B, participants did not have the time or means to get into a deep search for biological solutions as mentioned previously, so they were able to only mention the addition or removal of different elements or pos-

sible habitats in the ecosystem. From a biomimetic perspective, this was highly simplified, but the purpose of the activity shifted to opening up citizens' perspectives of what could be improved in the context. This was due to our second and third principle of working with people and working with local nature, which focus on the exploration of synergistic human-nature relations to become experientially available for participants, regardless of their backgrounds, as well as engaging participants in a process that focuses their attention on the non-human life around them. This resulted in suggestions that could be further explored in other workshops and initiatives for urban greening.

The next steps in the biomimetic process of abstracting a biological model and extracting design principles were only touched upon with participants by presenting wetlands as the biological model behind the floating islands innovation. This was because we wanted to reserve more time for our fourth principle of making things with citizens, so activity B.2 (Floating Islands) only aimed to give participants an overview of how wetlands function and how these functions can be transferred in design.

In the hands-on activity, we managed to engage participants in a materially tangible activity that led citizens to having a discursive dialogue with nature, in the sense that they did not only think of the biomimetic outcome, but also the natural materials that were used and why, as well as their implications in the local ecosystem where they would be placed.

The biomimetic process part of the workshop was intentionally left open-ended, so that we tried to emphasize its experimental nature and the implications that ecosystem biomimicry poses. As mentioned previously, having ecosystems as biological models is a complex approach to biomimicry and the more functions are being mimicked, the more efficient the overall performance of the biomimetic design. Thus, future interventions could focus on more specific functions for improving the water quality in Kildevældsparken, but also other ways of enhancing the connectivity between the ecosystem elements of the park, including potential solutions for creating a balance between existing human-nature relations.

Since we employed a weak approach to biomimicry, focused on the cultivation of synergistic human-nature relations and the ontological shift to design from within nature's mindset, we position our design experiment within our Biomimicry for Sustainability framework as shown in figure 16 below. By embedding the physical prototype in a broader process-oriented prototype of our design experiment, we claim to have demonstrated a biomimetic

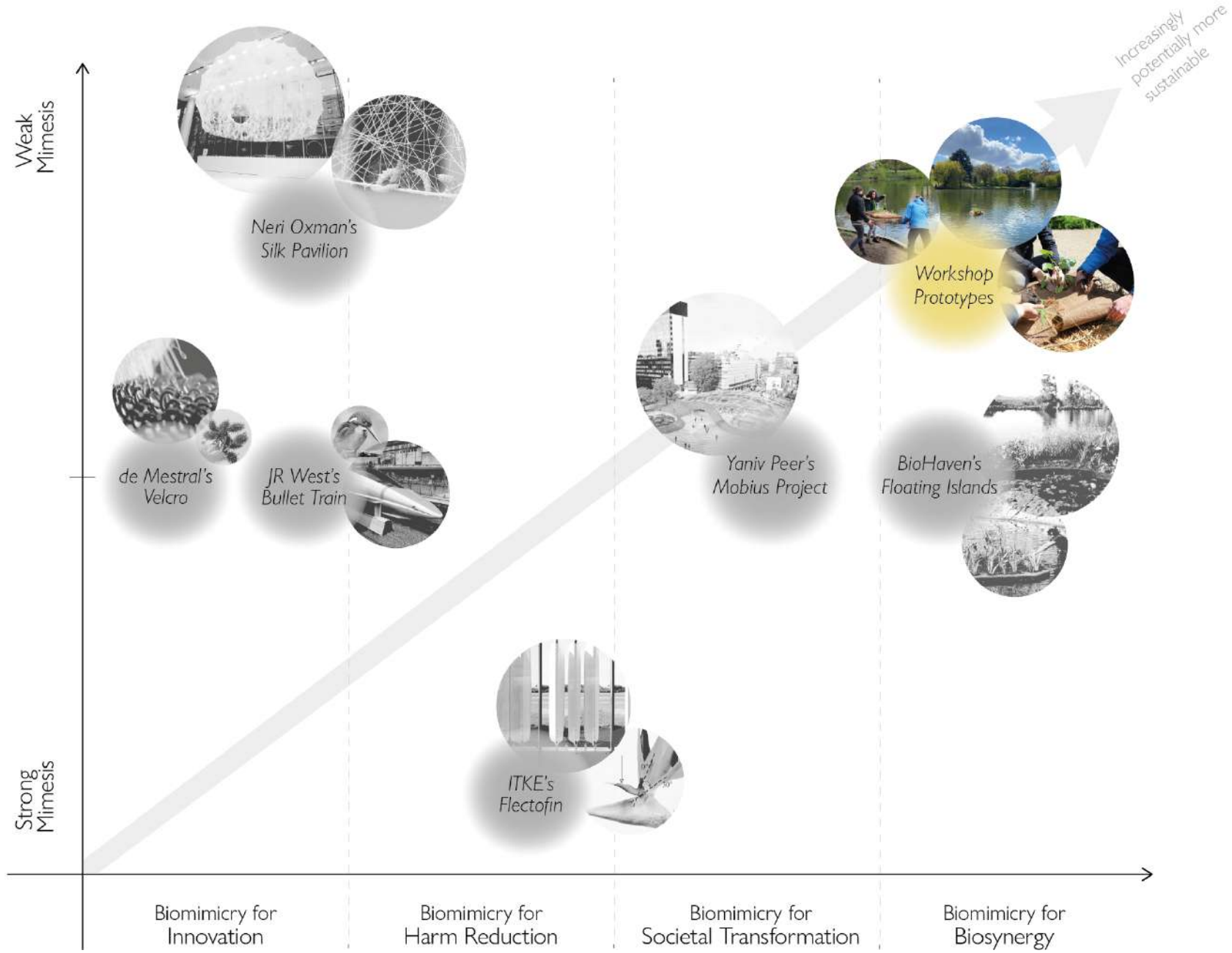


Figure 16: This diagram shows where we would place our design experiment (the floating islands) into the biomimicry framework.

process that enabled biosynergistic reflections on human-nature relations - as signalled by participants' questions *What do we really need? What is our point of view?*

Nevertheless, from a methodological perspective, we did not get deep into the biomimetic process as a means for innovation. As also our biologist and biomimicry expert, Lars pointed out, the way biomimicry was used in the workshop "[..] was more a cover story, than it was an innovation method to use with the participants", but at the same time he recognized that: "I don't think we could have had more time for it" (Lars - See Appendix 19). Some of the participants, however, expressed their wish for a more in-depth overview of the way biomimicry is employed in innovations during the feedback session. Kasper and Nicola, both suggested that it would have been beneficial to expand more on what kind of industries are using this design approach, typical examples of biomimetic innovations and to what extent is it applied (See Appendix 19).

urban greening context

As an urban greening workshop, our design experiment was engaging on multiple levels. First, although the workshop went over an hour than initially planned, all of the participants [24] stayed to finish the islands and install them into the lake. As Emilie and Sara shared with us after, this was not always the case in their experiences of conducting workshops, as well as the balanced levels of engagement among the participants throughout the crafting process. The hands-on activity allowed participants to tangibly contribute to the socio-spatial environment, with the aim of empowering them to take collective action on sustainability challenges. As was articulated by one of our participants, the workshop was able "to bring people together, create ideas, and show that change is actually possible through practical work building the floating island." (Allan - See Appendix 19). The positive feedback loops (as discussed in our design experiment principles - see Box 3), became a function not only for human-nature relations but also for inter-human relations.

We also observed that the construction process itself heightened the interests of bypassers, as they stopped to watch the participants building the islands, at times asking what we were doing. In fact, as the participants were placing the islands in the lake, one mother stopped a participant to ask him if she could pay for these activities to be done with her children in the future. Even after the workshop ended and the participants left, the presence of the islands in the lake continued to engage bypassers in the park as several of them came to us with questions as we were

[24] Except for our fellow facilitators Lars, Sara, Emilie who left at the time the workshop was planned to end.

cleaning up the mess. Thus, the design experiment demonstrated the integral role of tangible outcomes within urban greening activities, in not only engaging participants in a collective activity, but also mobilising possibilities for future involvement. As stated in our fourth design experiment principle:

> Material outcomes of urban greening activity practices also act as testimonies of citizens' work and can generate further interest and activities.

However, the windows of opportunity for future possibilities that arise during such activities must be explicitly considered before-hand and designed into the process, so that clear next steps can be given to interested bypassers. Although this was our intention with the leaflets (and Thomas), the next steps were not presented clearly as the leaflet stated "Stay tuned for further workshops with Miljøpunkt Østerbro and Kultur Ø", yet did not include any relevant links or contact information. In retrospect, we should have perhaps discussed the leaflets in more detail with our collaborators to ensure a coherent platform of communication for future participants (e.g. the addition of a QR code to Miljøpunkt Østerbro's newsletter).

In addition, during our group discussions after the workshop, our collaborators from Miljøpunkt Østerbro and Kultur Ø gave us feedback regarding the timing of the event and the co-creating process. Although they were delighted to hear that the participants stayed until the end (despite the workshop going over an hour), they recommended to consider shortening the floating island construction process, by preparing certain parts of the islands before the event and having clear instructions for assembling them. However, had we done this, cutting the bamboo sticks into the size we had considered for our initial prototype for example, the space for collaborative creativity and analogous thinking would have been significantly limited. As Fisch points out, "innovative design is not something out there to be found in nature, but rather something that emerges through inspirational technics of interaction with material nature" (2017, p. 806). We argue that this emergent quality of design should be a central point of consideration in the staging, leaving space for material things to perform as active participants in the 'DIT' process. Thus, (timing) priority should be given to this part of the workshop, such that the crafting process becomes a co-creative experience, rather than a group manufacturing activity. In this way, participants can have the opportunity not only to create a physical outcome, but also to mobilise their knowledge, reflections, and perspectives through material iterations.

The experiment also demonstrated an intellectual engagement that was a central objective of our workshop. Our aim was to challenge people's perceptions and open up the nature of Kildevaeldsparken as a matter of concern, by having participants reflect on and relate to nature based on their own experiences and within the spatial context. In this way, the process, in which we integrated the hands-on activity, gave participants the opportunity to explore more deeply human-nature relations and intellectually engage in urban greening from within 'nature's mindset'. As formulated by one of the participants, the workshop "showed that [Kildevaeldsparken is] more than just a park to walk around, it is part of a much more complex system; that the layperson takes for granted. Eye-opening." (Felipe - See Appendix 19).

The complex dynamism of nature was brought to light, whereby the natural setting of the park was no longer treated as a passive setting for human activity, and the construction of the floating islands demonstrated a tangible generative impact from humans to nature. However, the tensions between human-centred and ecological values that we punctuated in our sensitivity analysis and the participants' articulations of the issue is a deeply rooted dualism dominating current human-nature relations, which our four-hour workshop did not intend to resolve, but rather open up the space for future deliberation and action. Hence, it is important to note that such spaces for deliberation should not be assembled, nor treated in isolation. Rather, as Karvonen points out, urban greening activities should be understood as social, cultural, and political interventions, so that "individuals and organisations [can] identify commonalities and nurture relations between potential collaborators" (2015, p 282).

She further argues that a pivotal element of the assembly of such socio-material relations is "the need for a clear narrative to describe such projects" (2015, p. 282). Hence, we propose the narrative of biomimicry and synergistic human-nature relations as not only an engaging 'cover story' to express intentions but also to reshape them (Beauregard, 2003, as cited in Karvonen, 2015), by which urban greening efforts can gain the transformational momentum needed for urban sustainability transitions based on holistic conceptions of nature.

SDE perspective

Equipped with a staging perspective that heightens our sensitivity toward the human and non-human elements employed in our experiment, we briefly reflect here on our workshop considerations, highlighting particular aspects relevant for designers to take

into account when staging design experiments.

The timing of our workshop and the individual activities was an important, yet challenging dimension. As Sanders points out, "the timing of the session is often the hardest part to learn" (2020, p. 65). Although the workshop had been planned to run for three hours, we noticed that some activities could have had more space for dialogical development, such as the group problematisation discussion in part A.6. Thus, designers should take into consideration the priority of each activity as well as take the time (if possible) to have a trial-run of the workshop to better estimate the timing of each activity and the entire event (Sanders, 2020). Perhaps, we could have divided our workshop into two days, one for Part A and the other for Part B, so that more room was left open for participants' articulations of the problem, their group explorations of possible solutions, as well as group reflections on the physical outcome of the workshop.

Related to the timing of the experiment are also considerations regarding the level of complexity and detail of the activities. Some of the collaborative interactions we planned in Part A could have, for instance, included more physical interaction with the game materials, so that participants could have had the opportunity to freely play around with the ecosystem elements (e.g. the ecosystem elements could be written on individual cards and players could be asked to create relationships between them to form the nutrient cycle). We also could have incorporated role-playing games as a way for challenging human-nature relations where participants would take roles of natural elements in the "nature" realm to find biological models.

The design experiment was also considered from our role as researchers, such that the workshop became "a part of the situation on which to reflect and construct knowledge from" (Johansen & Lindegaard, 2020, p. 202). Thus, it is crucial for designers to consider how their role as observers can be translated into material artefacts or into other performances. In our case, it proved challenging to enrol Lars, Emilie, and Sara as observers of our experiment; however the use of Think Boxes was a useful tool for collecting empirical data. Perhaps we could have given material objects as props for the observer's role or more explicitly described in the workshop plan 'script' in order to better mobilise their presence in our workshop for gathering empirical data. It is also important to consider the formulation of the questions in the Think Box. We noticed that the more abstract questions, like what is a park? and what is a lake?, gave an interesting variety of responses, however given the open-endedness of the question some responses were very

brief, at times two-word responses. Nevertheless, positioning some of the think boxes as starting points for group discussions elicited the articulation of more in-depth responses from participants.

As Munthe-Kaas and Hoffmann (2017; 2020) point out, the invitation is also a central consideration as it frames who is invited on the stage and what futures can be explored. Based on our experience, it would have been useful to consider our leaflets also as a form of invitation, by which we could have designed entrance points into our workshop that could have allowed interested bypassers to get involved in the workshop without having participated from the start. During the workshop, Thomas encountered a disgruntled bypasser, who felt excluded from the workshop. She referred to our poster, reading "DIT Osterbro", saying that this was her neighborhood and her park and questioned, with palpable irritation, why she hadn't seen this invitation, why she was not asked to participate. At this point, Emilie quickly stood up and helped Thomas console the bypasser, as this was not the first time she had encountered individuals with these reactions to workshops (See Appendix 19). Thus, designers should consider invitations also in terms of the timing of the experiment and how the format can allow for the possibility of spontaneous invitees.

Additionally, we should have taken account of the varying layouts of the different platforms on which we digitally and physically shared our invitation (picture above). Based on Miljopunkt Østerbro's audience data, our invitation was not seen by many newsletter readers, since there was too much text in the image (See Appendix 19). In their newsletter layout, there are designated sections for images and for text, thus our combined layout did not suit the platform, which limited the amount of people that read the invitation. Thus, in addition to considering the implications invitations have on 'stakeholderness' (ibid.), designers should also account for the different forms invitations can take based on the communication platforms.

sub-conclusion

The design experiment provided us with valuable insights on the potential that biomimicry can bring to urban greening as a means to explore and reflect on the human-nature relations in a local context together with citizens.

Firstly, through our sensitivity analysis, we explored the main actors and relationships from the urban greening context, which showed that there is a momentum of engaging citizens in urban

greening activities in Østerbro that go beyond aesthetic values. However, there are various challenges and values that urban greening actors have to navigate in building the green network. All these insights informed our principles and design process for how we would like to test biomimicry in the local context. The sensitivity process thus led the two concepts (of urban greening and biomimicry) to shape and influence each other, while it enrolled actors supporting each network to enter an experimentation space for challenging existing values and practices.

Secondly, through the workshop staged we had the opportunity to experience first in hand on how a biomimetic approach to urban greening could unfold in practice, as well as ways in which an urban park (i.e. Kildevældsparken) could be turned from a matter of fact into a matter of concern in the process, in order to explore human-nature relations and common world building in with citizens.

The problem-driven biomimetic process employed was more iterative, fluctuating between nature and context in order to be able to give citizens both the necessary background knowledge and the opportunity to make things in practice within a limited time frame. In addition, in order to explore the potential of "biomimicry for biosynergy" and have a more reflective dialogue with nature, the biomimetic process was highly simplified, so that we could create a balance between theory and citizen engagement and reflection.

As an urban greening strategy, having a biomimetic approach managed to engage citizens on multiple levels and shift the outcome of urban greening activities beyond the human and ecological gains. As one of the participants stated, the workshop was "eye opening" (Felipe - See Appendix 19) and able to give direct and indirect participants (i.e. by-passers) a different perspective on nature and their relations to the non-human life of cities. Besides the intellectual engagement, having a hands-on activity of building biomimetic prototypes demonstrated a tangible impact from humans to nature that had a deeper implication than simply greening the city through gardening activities.

Furthermore, as designers, we had a lot to learn from staging the workshop. Since there had to be a fine balance between theory and practice, timing was an issue that should be further considered in these types of interventions. In addition, having ecosystem biomimicry as a focus, it poses a high level of complexity, but opens the opportunity for reflections on deeper implications along the process. Thus, the degree of sophistication is another balance to consider when planning the workshop activities. An-

other fine line is between the ability to carry out observations during the workshop, as well as the ability to facilitate. Having visuals and Think Box activities were a great help in this intervention, although there is room for improvement and exploration of alternative methods.

Finally, in terms of mobilisation of actors through the design experiment, our intervention managed to bring existing actors from the green network closer together as well as enroll new actors to join the momentum of taking urban greening to a new level through a biomimetic approach. Biomimicry and its promises proved to be a good interessment device, as it is a novel and exciting way of exploring nature and approaching problems. This has been used in the design experiment to both mobilise urban greening actors (i.e. our collaborators) and the local community by building a biomimetic prototype that could be left in the park. Moreover, biomimicry also proved to be a suitable framework that can support reflections upon human-nature relations and sustainability challenges, thus supporting the mobilisation of the developing green network in the local context while expanding the network around biomimicry, proved to be a promising way of creating positive feedback loops between humans and nature. However, the successful mobilisation of the two networks can only be done if there are actors that are willing to take a central role as navigators, thus the design experiment requires additional interventions to support and empower potential future navigators in the network.

conclusion

Challenges of sustainability, which define the current geological epoch of the Anthropocene, are marked by complex entanglements of human and natural agencies. Thus, conceptual developments within sustainability and design discourse have shifted from isolated and incremental framings toward more hybrid understandings and approaches to sustainability challenges. In this thesis, we adopted a procedural conceptualisation of sustainability, rooted in constructivist social theories, to ultimately open up discussions surrounding the potential role of biomimicry as a novel relational approach to human-nature relations. By taking the growing urban greening agenda in Østerbro, Copenhagen to contextualise and operationalise our experimentation, we set out to mobilise biomimicry as a network and as a function for process-oriented urban greening activities.

Rooting our focus on human-nature relations in recent discussions within sustainability, design, and urban greening discourse (Latour, 2011; Haraway, 2003; Maggs & Robinson, 2016; Wahl 2006; Escobar, 2017, Karvonen, 2015; Cooke, 2020), we argue that a fundamental shift is needed in the dominant dualist conception of nature, in order to cultivate synergistic responses to sustainability challenges. In this way, the aim of these responses "is not so much to reduce our impact as to make that impact generative for nature" (Mathews, 2011, p. 4). Following this argumentation, we first review and develop upon methodological and conceptual considerations of biomimicry, in an effort to contribute to the growing calls in the literature for more reflective discussions. We propose a framework (see figure 05) as a possible direction for further theorisation of biomimicry that synthesises recent reflective deliberations in the literature, and aims to elaborate on the potential of biomimicry to cultivate more sustainable human-nature relations.

Based on this, we take the role of navigators and, through a compositionist design approach, we set out to make our discussions of 'biomimicry for biosynergy' and synergistic human-nature relations experientially available through a collaborative design experiment. We, thus, further develop our translation of biomimicry with sensitivity toward our urban greening context, in terms of the socio-material dynamics of our collaborators' agendas and our chosen physical context. Formulating our application of biomimicry in terms of principles, we develop and stage a design experiment with the intention to make tangible our experimentation with biomimicry as a function for process-oriented urban greening strategies that can open up spaces for reflection on and new articulations of human perspectives and relations with nature.

Ultimately, in practice, our translation of biomimicry served as a materially and intellectually engaging story around which we framed the urban greening design experiment. In this way, the synergistic narratives of biomimicry can be seen as a potential response to the "view [of] nature through conventional lenses of recreation or ecological science" present in urban greening discourse (Karvonen, 2015, p. 282). Thus, through the development and staging of our design experiment, we demonstrated how relations can be mobilised, both socially and materially, around the concept of biomimicry such that growing urban agendas can gain the transformational momentum needed to move toward more sustainable urban futures.

As we identified the three starting points at the outset of this report, here we propose three exit points of our project, formulated as questions:

(a) *How can biosynergistic outcomes be conceived and measured?*

(b) *What competencies do urban greening actors need for mobilising new socio-ecological-technical realities in the city?*

(c) *How can localised design experimentation contribute to ongoing processes of common world-making and broader sustainability transitions?*

discussion

In this final section, we elaborate on our third exit point of Sustainable Design Engineering, discussing the implications of our thesis on the evolving field and emerging practitioners. In line with our brief introduction to the co-evolving developments in sustainability and design discourse, we highlight here the centrality of the notion of hybridity.

Particularly, sustainability challenges, marking the current geological epoch of the Anthropocene, can be framed as 'hybrid issues' or characterised by "increasing levels of hybridity (i.e. socio-technical-natural systems)" (Maggs & Robinson, 2016, p. 176). This framing highlights the increasingly growing and interlacing threads of human and non-human agencies and the need to develop methodological and ontological approaches that are sensitive to this hybridity. In this way, we can avoid the subsumption of new societal challenges and their reduction to specialised disciplinary tasks within existing institutional frameworks (Valderrama, Jørgensen & Jensen, 2018).

Hence, through this research we have aimed to open the discussion about the role of Sustainable Design Engineers in bridging different disciplines towards a common understanding that addresses problematic human-nature relations characteristic of the current epoch of the Anthropocene. This paper brings a particular focus on biomimicry and urban greening, but we acknowledge that there are various other fields where, we argue, that SDE should seek to position itself at their intersection.

This is a very challenging, but also privileged role for SDE practitioners. Sustainability is a very broad term, with various, at times contesting, conceptualisations and hybrid implications. Thus, through this research we took our vantage point in procedural sustainability, in particular, to navigate this hybridity and open up spaces for discussion and negotiation about desired futures via the staging of a design experiment. This is a more exploratory approach whose outcome is difficult to quantify and measure, but which aims to develop people's role and perspectives towards design that is regenerative (i.e. net-positive effect), rather than mitigating negatives (i.e. net-zero effect).

As this approach is highly conceptual, a challenge encountered as SDE practitioners was in finding the best way to communicate, in a practical sense, all the different concepts being employed in this project to actors with whom we collaborated. Hence, the competences needed as designers transitioned into the ability to transfer knowledge to other actors in the network. For instance, the methodological considerations for biomimicry, as well as the debate around human-nature relations were highly abstracted and shared through various means, often visual, and non-human actors in order to be able to translate them into urban greening practices. This gave us the opportunity to be creative, but also posed the risk of being reductionist in our knowledge sharing

with the collaborators and the citizens engaged in the design experiment. However, we believe that there should be several interventions staged as part of a project in order to be able to make people in the local context get the same level of understanding of the underlying implications for each concept.

The implications of having this approach in doing design are that we no longer design objects, but rather 'draw things together'. Following Latour's (2008) line of thought, designing becomes a practice of reconfiguring networks by bringing actors together around different matters of concern. For us as professionals, the challenge is to merge our previous background knowledge with this novel perspective on our role as designers and make other actors outside of our field not only aware of our competences, but also the need to acknowledge and approach challenges as hybrid objects. Thereby, we find the experimental and situated approach to sustainability employed in this paper as a valuable means to get other actors to understand and benefit from our role as professionals.

Having biomimicry as a concept in our research, contributed to moving beyond profoundly philosophical understandings of nature into a tangible translation that can be employed in actionable strategies for urban greening. Through this project, we investigated how biomimicry could be employed in a specific context, thus, further research would have to be done in order to experiment with other local settings and observe potential patterns for methodological considerations. Furthermore, we believe that biomimicry is a valuable concept for SDE, as it reflects and builds upon the interdisciplinary and problem-driven approach fundamental to the education at Aalborg University.

In terms of the theoretical framework that we employed in this paper, the navigational approach offers an elucidative conceptual lens for designers whose work centres around the navigation of multiple or hybrid realities, perspectives, relations, and agendas. An alternative theoretical direction we could have taken in exploring how to mobilize new socio-ecological-technical realities in the city is the sustainable transitions perspective, as operationalised by the 'Participatory Design Visioning' design strategy (Gaziulusoy and Ryan, 2017). This would have been interesting in bringing to light valuable insights on how to imagine alternative futures in the city, and support structural changes within society by establishing different kinds of knowledge. Similar to the sensitivity analysis, Gaziulusoy and Ryan (2017) propose problem mapping as a first step, after which they suggest consolidating concerns and expectations into a co-created vision of the future from which there can be derived various transition pathways. Hence, the present research focused to bridge different understandings and experiment into a local context, but further research could be built upon these insights for experimentation towards common world-making.

Finally, we would like to consider the role of narratives in our project and within sustainability discourse in general. Throughout our research, we found concerns around narratives, a central theme within the plural areas we explored (both in-depth and tangentially) including biomimicry, urban greening, civic action, governance, and urban futures. Although it was not a highlighted focus of our research and experimentation, the role of biomimicry as a narrative within the broader urban greening agenda of our chosen context came to light as a result of our staging and mobilisation considerations. We saw that 'biomimicry' acted, in practice, as a narrative embodying the conceptual deliberations surrounding synergistic human-nature relations and holistic conceptions of nature. Thus, we would like to foreground here the dominant and plural role of narratives central to sustainability work and turn designer's attention to the multiple means by which narratives are formed, translated, and mobilised in design work and their implications on future possibilities and directions of development. In this way, narratives can become a key practical and analytical tool for navigating the hybridity of issues and approaches fundamental to the SDE field, by which our plural, intersectional positions as practitioners can gain coherence and institutional momentum.

references

Aalborg University. (n.d.). The Aalborg Model for Problem-Based Learning. Retrieved May 30, 2021, from https://www.en.aau.dk/about-aau/aalborg-model-problem-based-learning/

Benyus, J. M. (n.d.). A Biomimicry Primer. Retrieved May 30, 2021, from https://biomimicry.net/the-buzz/resources/a-biomimicry-primer/

Benyus, J. M. (1997). *Biomimicry: Innovation Inspired by Nature.* New York: Morrow.

Binder, T., Brandt, E., Ehn, P., & Halse, J. (2015). Democratic Design Experiments: Between Parliament and Laboratory. *CoDesign, 11*(3-4), 152-165.

Biomimicry Institute. (n.d.-a). *AskNature - Innovation - High Speed Train Inspired by the Kingfisher.* Retrieved May 28, 2021, from https://asknature.org/innovation/high-speed-train-inspired-by-the-kingfisher/

Biomimicry Institute. (n.d.-b). *Versatile Fastener Inspired by Burrs - Innovation - AskNature.* Retrieved May 28, 2021, from https://asknature.org/innovation/versatile-fastener-inspired-by-burrs/

Biomimicry Institute. (n.d.-c). *Versatile Water Treatment Garden Inspired by Wetlands - Innovation - AskNature.* Retrieved from May 28, 2021, https://asknature.org/innovation/versatile-water-treatment-garden-inspired-by-wetlands/

Biomimicry Institute. (n.d.-d). *Interacting Organisms Remove Nutrients Biological Strategy - AskNature.* Retrieved May 30, 2021, from https://asknature.org/strategy/interacting-organisms-remove-nutrients/

Biomimicry Institute. (2005). *Versatile Water Treatment Garden Inspired by Wetlands - Innovation - AskNature.* Retrieved April 24, 2021, from https://asknature.org/innovation/versatile-water-treatment-garden-inspired-by-wetlands/

Biomimicry Institute. (2016). *AskNature - Innovation Inspired by Nature.* Retrieved from https://asknature.org/

Blok, V., & Gremmen, B. (2016). Ecological Innovation: Biomimicry as a New Way of Thinking and Acting Ecologically. *Journal of Agricultural & Environmental Ethics, 29*(2), 203–217.

Brandt, E. (2007). How Tangible Mock-ups Support Design Collaboration. *Knowledge, Technology & Policy, 20*(3), 179–192.

Brandt, E., Messeter, J., & Binder, T. (2008). Formatting Design Dialogues: Games and Participation. *Co-Design, 4*(1), 51–64.

Buck, N. T. (2017). The Art of Imitating Life: The Potential Contribution of Biomimicry in Shaping the Future of Our Cities. *Environment and Planning B: Urban Analytics and City Science, 44*(1), 120–140.

Buijs A.E., et al. (2016). Active Citizenship for Urban Green Infrastructure: Fostering the Diversity and Dynamics of Citizen Contributions through Mosaic Governance. Curr Opin Environ Sustain, 22, 1–6.

Callicot, J. (1984). Non-Anthropocentric Value Theory and Environmental Ethics. *American Philosophical Quarterly, 21*(4), 299–309.

Callon, M. (1986). Some Elements in the Sociology of Translation: Domestication of the Scallops and the Fishermen of St. Brieuc Bay. In *J. Law (Ed.), Power, Action and Belief: A New Sociology of Knowledge* (pp. 196–223). Abingdon: Routledge and Kegan Paul.

Ceschin, F., & Gaziulusoy, İ. (2019). *Design for Sustainability: A Multi-level Framework from Products to Socio-technical Systems*. Routledge.

Cohen, Y. H., & Reich, Y. (2016). *Biomimetic Design Method for Innovation and Sustainability.* Berlin, Germany: Springer.

Connelly, S. (2007). Mapping Sustainable Development as a Contested Concept. *Local Environment, 12*(3), 259–278.

Cooke, B. (2020). The Politics of Urban Greening: An Introduction. *Australian Geographer, 51*(2), 137-153.

Dama-Fakir, P., et al. (2018). *Biomimicry and Wetlands.* Water Research Commission. Republic of South Africa.

Dopazo, J. (2021). *How the 'Do It Yourself' Movement is Evolving into 'Do It Together'.* Being Boss. Retrieved 20 May 2021, from https://beingboss.club/articles/diy-do-it-together.

Dorland, J., & Vinck, D. (2020). Staging Collaborative Design and Innovation: An Introduction. In *Staging Collaborative Design and Innovation* (pp. 2–19). Edward Elgar Publishing.

du Plessis, C. (2012). Towards a Regenerative Paradigm for the Built Environment. Building Research & Information, 40(1), 7–22.

Escobar, A. (2017). *Designs for the Pluriverse: Radical Interdependence, Autonomy, and the Making of Worlds.* Durham; London: Duke University Press.

European Commission. (2007). *LIFE and Europe's Wetlands: Restoring a Vital Ecosystem.* Luxembourg: Office for Official Publications of the European Communities.

Favas, P. J., Pratas, J., Paul, M. S., Sarkar, S. K., & Prasad, M. N. V. (2016). Phytofiltration of Metal (loid)-contaminated Water: The Potential of Native Aquatic Plants. In *Phytoremediation* (pp. 305–343).

Fisch, M. (2017). The Nature of Biomimicry: Toward a Novel Technological Culture. *Science, Technology, & Human Values, 42*(5), 795–821.

Fiskeøkologisk Laboratorium. (2013). Miljøtilstanden i Københavns Søer, Biologisk Screening.

Floating Island International. (2016). *Research: Floating Island International, Inc.* Retrieved May 5, 2021 from https://www.floatingislandinternational.com/research-papers.html

Floating Islands West. (n.d.). *Floating Islands West Photo Gallery.* Retrieved May 5, 2021, from https://floatingislandswest.com/portfolio_page/floating-islands-west-photo-gallery/

Frantzeskaki N. et al. (2016). Elucidating the Changing Roles of Civil Society in Urban Sustainability Transitions. *Current Opinioin in Environmental Sustainability 22*, 41–50.

Gaziulusoy, I. (2019). Postcards From "the Edge": Toward Futures of Design for Sustainability Transitions. *Cuadernos Del Centro de Estudios de Diseño y Comunicación, 73*, 66–83.

Gaziulusoy, I. & Öztekin, E. (2018). Design as a Catalyst for Sustainability Transitions. D*esign Research Society International Conference: Catalyst. DRS International Conference Series.* 1041–1051.

Gaziulusoy, A. İ., & Ryan, C. (2017). Shifting Conversations for Sustainability Transitions Using Participatory Design Visioning. *The Design Journal, 20*(1), 1916–1926.

Goldstein, J., & Johnson, E. (2015). Biomimicry: New Natures, New Enclosures. *Theory, Culture & Society, 32*(1), 61–81.

Hailwood, S. (2000). The Value of Nature's Otherness. *Environmental Values, 9*(3), 353–372.

Hansen, P. R., & Clausen, C. (2017). Management Concepts and the Navigation of Interessement Devices: The Key Role of Interessement Devices in the Creation of Agency and the Enablement of Organizational Change. *Journal of Change Management, 17*(4), 344–366.

Haraway, D. (2003). *The Companion Species Manifesto: Dogs, People, and Significant Otherness.* Chicago: Prickly Paradigm Press.

Helmrich, C. et al. (2020). Using Biomimicry to Support Resilient Infrastructure Design. *Earth's Future, 8*(12), 1–18.

Helms, M., Vattam, S. S., & Goel, A. K. (2009). Biologically Inspired Design: Process and Products. *Design Studies, 30*(5), 606–622.

ISO 18458 (2015). Biomimetics: Terminology, Concepts and Methodology. Berlin: Beuth.

Ives, C., Abson, D., von Wehrden, H., Dorninger, C., Klaniecki, K., & Fischer, J. (2018). Reconnecting with Nature for Sustainability. *Sustainability Science, 13*(5), 1389–1397.

Johansen, A. G. & Lindegaard, H. (2020). Storytelling Urban Nature: Situated Intervention as Environmental Theatre. In *Staging Collaborative Design and Innovation* (pp. 200–214). Edward Elgar Publishing.

Karvonen, A. (2015). Pathways of Urban Nature: Diversity in the Greening of the Twenty-first Century City. In *Now Urbanism: The Future City is Here* (pp. 274–285). London: Routledge.

Kennedy, E. et al. (2015). Biomimicry: A Path to Sustainable Innovation. *Design Issues, 31*(3), 66–73.

Københavns Kommune. (n.d.-a). *Københavns Kommunes Agenda 21-Strategi.* Retrieved February 16, 2021, from https://www.kk.dk/artikel/baeredygtige-sammenhaenge-koebenhavns-kommunes-agenda-21-strategi

Københavns Kommune. (n.d.-b). *Vand og VVM.* Retrieved April 20, spectives and Research Trajectories. *Sustainability Science, 8*(2), 279–293.

Munthe-Kaas, P., & Hoffmann, B. (2017). Democratic Design Experiments in Urban Planning: Navigational Practices and Compositionist Design. *Co-Design, 13*(4), 287–301.

Munthe-Kaas, P., & Hoffmann, B. (2020). Staging Urban Design through Experimentation. In *Staging Collaborative Design and Innovation* (pp. 215–230). Edward Elgar Publishing.

Nordic Biomimicry. (n.d.). *WHO WE ARE*. Retrieved May 25, 2021, from

https://www.nordicbiomimicry.org/who-is-center-of-nordic-biomimicry/
O'Neill, J. (1992). The Varieties of Intrinsic Value. *The Monist 75*(2), 119–137.
O'Neill, J., & Spash, C. (2000). Conceptions of Value in Environmental Decision-Making. *Environmental Values, 9*(4), 521–535.
Østerbroliv.dk. (2021, May 18). *Flydende små øer i Kildevældssøen: De skal mime naturen* (T. Frederiksen, Ed.). Retrieved May 27, 2021, from https://osterbroliv.dk/artikel/flydende-sm%C3%A5-%C3%B8er-i-kildev%C3%A6ldss%C3%B8en-de-skal-mime-naturen?fbclid=IwAR01c_PGToMoVOOdUGZlP1R8dv85sdNDFQD5GefW-q8BjPPnKC4U2mMIp50o
Overbeek, C. C., Harpenslager, S. F., van Zuidam, J. P., van Loon, E. E., Lamers, L. P., Soons, M. B., & van der Geest, H. G. (2020). Drivers of Vegetation Development, Biomass Production and the Initiation of Peat Formation in a Newly Constructed Wetland. *Ecosystems, 23*(5), 1019–1036.
Paris21 (2018, 4 April). *Conference Summary. Truth in Numbers: The Role of Data in a World of Fact, Fiction and Everything in Between.* Bern, Switzerland.
Pavlineri, N., Skoulikidis, N. T., & Tsihrintzis, V. A. (2017). Constructed Floating Wetlands: A Review of Research, Design, Operation and Management Aspects, and Data Meta-Analysis. *Chemical Engineering Journal, 308*, 1120–1132.
Pawlyn, M. (2019). *Biomimicry in Architecture.* Routledge.
Pedersen Zari, M. (2015). Can Biomimicry Be a Useful Tool for Design for Climate Change Adaptation and Mitigation? In *Biotechnologies and Biomimetics for Civil Engineering* (pp. 81–113). Springer International Publishing.
Pedersen Zari, M. (2018). *Regenerative Urban Design and Ecosystem Biomimicry*, 1st ed. Routledge: Abingdon-on-Thames, UK.
Randrup et al. (2020). Moving Beyond the Nature-Based Solutions Discourse: Introducing Nature-Based Thinking. *Urban Ecosystems 23*, 919–926.
Reed, P. (2004). A Paradigm Shift: Biomimicry. *The Technology Teacher, 63*(4), 23–27.
Reed, W. E. (2007). Shifting from 'Sustainability' to Regeneration. *Building Research & Information, 35*(6), 674–680.
Robinson, J. (2004). Squaring the Circle? Some Thoughts on the Idea of Sustainable Development. *Ecological Economics 48*, 369–384.
Robinson, J., & Cole, R. (2015). Theoretical Underpinnings of Regenerative Sustainability. *Building Research and Information: the International Journal of Research, Development and Demonstration, 43*(2), 133–143.
Samal, K., Kar, S., & Trivedi, S. (2019). Ecological Floating Bed (EFB) for Decontamination of Polluted Water Bodies: Design, Mechanism and Performance. *Journal of Environmental Management, 251*, 109–150.
Sanders, E. B. N. (2020). Staging Co-Design within Healthcare: Lessons from Practice. In *Staging Collaborative Design and Innovation.* Edward Elgar Publishing.
Soga, M. & Gaston, K. J. (2016). Extinction of Experience: the Loss of Human-Nature Interactions. *Frontiers in Ecology and the Environ ment*, *14*(2), 94–101.
Speck, O. et al. (2017). Biomimetic Bio-inspired Biomorph Sustainable? An Attempt to Classify and Clarify Biology-Derived Technical Developments. *Bioinspir. Biomim. 12*, 1–15.
Stewart, F. M., Muholland, T., Cunningham, A. B., Kania, B. G., & Osterlund, M. T. (2008). Floating Islands as an Alternative to Constructed Wetlands for Treatment of Excess Nutrients from Agricultural and Municipal Wastes: Results of Laboratory-Scale Tests. *Land Contamination & Reclamation, 16*(1), 25–33.
Tague, N. R. (2009). *The Quality Toolbox.* Milwaukee, Wis.: Asq Quality Press.
Uchiyama, B. (2020). Application of Biomimetics to Architectural and Urban Design: A Review across Scales. *Sustainability (Basel, Switzerland), 12*(9813), 1–15.
Vaajakallio, K., & Mattelmäki, T. (2014). Design Games in Co-Design: As a Tool, a Mindset and a Structure. *Co-Design, 10*(1), 63–77.
Valderrama Pineda, AF , Jørgensen, U. , & Iuel-Stissing, J. (2018). Tran-

sition Design . 1-19. *Dissertation presented at 9th International Sustainability Transitions Conference*, Manchester, UK.

Wahl, D.C. (2006). Bionics vs. Biomimicry: From Control of Nature to Sustainable Participation in Nature. In *Design and Nature III: Comparing Design in Nature with Science and Engineering (Brebbia CA (ed.))*. WIT Press, Southampton, UK, WIT Transactions on Ecology and the Environment, vol. 87, 289–298.

Zaccone, C., Lobianco, D., Shotyk, W., Ciavatta, C., Appleby, P. G., Brugiapaglia, E., & D'Orazio, V. (2017). Highly Anomalous Accumula-

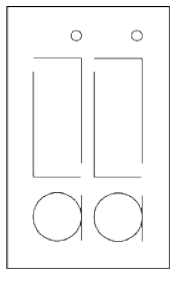
Master's Thesis | Final Project

Sustainable Design Engineering Master's Programme

Aalborg University Copenhagen - 04, June 2021

APPENDICES

01 | Bio-inspired design strategies



Team IILLAA
Author Lamiita Traista
Theme Research
Date 04.02.21
Appendix 01
Page 1 of 1

This worksheet presents biomimicry within other bio-inspired design strategies.

Biophilia / Biophilic design

Biophilia has been coined by Wilson (1986) to describe humans' need of connecting with nature and other forms of life (Biomimicry Institute, 2015) , aiming at human well-being.
Biophilic design and urbanism emphasizes the design of buildings and cities by integrating natural elements or systems the same way that they can be found in nature or adapted. (Xue et al., 2019)

Biomorphic design

"Biomorphic describes anything resembling or suggesting the forms of living organisms." (Biomimicry Institute, 2015)

Bio-assistance

Bio-assistance technology refers to using "[..] biological parts that already exist in nature to perform a biological function" (Jacobs, 2014, p. 87)
An example could be housing organisms and materials of the forest for filtering and cleaning waste water (Jacobs, 2014).

Bio-utilization

Bio-utilization refers to utilizing a product from nature, such as growing algae to make biofuels. (Biomimicry Institute, 2015)

Biomimicry

The core element that makes biomimicry stand out is function—it focuses on learning from how the living world is able to function, rather than aestehics. (Biomimicry Institute, 2015)

Interestingly, the concept of learing from nature is not new, but the usage of the term 'biomimicry' did not begin until 1990s (Jacobs, 2014). This adds to the confusion between the terms used to describe this concept.

Jacobs (2014) argues that biomimetics is the correct term for defining "the study of biological functions, the forms, processes and interactions for the purpose of solving analogous human problems" (Jacobs, 2014, p. 87), while biomimicry is actually "biomimetics for the purpose of developing sustainable innovations; sustainable biomimetics" (Jacobs, 2014, p. 87).

Another biomimetic approach is bionics which can be employed to "augument or replace a particular biological function with electronic or electromechanical components" (Jacobs, 2014, p. 87)

Uchiyama (2020) further claims that biophilic design can also be considered "[..] as a subcategory of biomimetic design" (Uchiyama, 2020, p.6) in the field of architecture and urban design, but this has been contested by other authors (Jacobs, 2014; Zari, 2008).

Zari (2008) suggests that while the other bio-inspired design strategies should not be confused with biomimcry, biomimetic development could as well "[..] draw upon these other strategies for design aesthetics or spatial design concepts" (Zari, 2008, p. 21).

References

Biomimicry Institute. (2015). Biomimicry Design Toolbox. Retrieved January 31, 2021, from Biomimicry Toolbox website: https://toolbox.biomimicry.org/

Jacobs, S. (2014). BIOMIMETICS: A SIMPLE FOUNDATION WILL LEAD TO NEW INSIGHT ABOUT PROCESS. International Journal of Design & Nature and Ecodynamics, 9(2), 83-94. doi:http://dx.doi.org.zorac.aub.aau.dk/10.2495/DNE-V9-N2-83-94

Uchiyama, B. (2020). Application of Biomimetics to Architectural and Urban Design: A Review across Scales. Sustainability (Basel, Switzerland), 12(9813).

Wilson, E. O. (1986). Biophilia (Reprint edition). Cambridge, Mass.: Harvard University.

Xue, F., Gou, Z., Lau, S. S. Y., Lau, S. K., Chung, K. H., & Zhang, J. (2019). From biophilic design to biophilic urbanism: Stakeholders' perspectives. Journal of Cleaner Production, 211, 1444-1452.

Zari, M. P. (2018). Regenerative urban design and ecosystem biomimicry. Routledge.

02 | History of Biomimicry-Related Terms

Team IILLAA
Author Lazaara Ilieva
Theme Research
Date 18.03.21
Appendix 02
Page 1 of 1

This worksheet synthesises the overview of biomimicry-related terms as presented by Speck et al. (2017), who argue for a system that describes the developmental history of biology-derived and technology-derived solutions, in response to the current diversity of terms and definitions and, at times, contrary explanations. Current technical rules and standards are also covered.

1950

_BIOMIMETICS

In 1957, American engineer and physicist, Otto Herbert Schmitt, coined the term 'biomimetics' as **a biological approach to engineering**, in contrast to 'biophysics'm which describes the engineering/physical approach to biology.

_BIONICS

In 1958, American medical doctor, Jack E. Steele, introduced the word 'bionics' in terms of **copying functions from nature** during his time at the Aerospace Medical Research Lab. The term was officially used in 1960 as the title of a three-day symposium at the Wright-Patterson Air Force in Dayton.

1970

_BIOMIMETICS

The term 'biomimetics' first appeared in 1974 in Webster's Dictionary defined as **the study of the formation, structure, or function of biological materials, mechanisms and processes in order to synthesise artificial products that mimic natural ones.** This description can be found today in Merriam-Webster's online Dictionary.

1990

_BIOMIMICRY

In 2002, American forestry scientist, Janine Benyus, popularised the term 'biomimicry', which means **learning from the natural world by imitating or taking inspiration from nature's designs and processes to solve human problems and using an ecological standard to judge the rightness of our innovations.**

_BIOMIMETIC PROMISE

In 2006, German biologist, Arnim von Gleich, coined the term 'biomimetic promise' to indicate that, because of the inspiratory flow from biology to technical products, **biomimetic solutions have the specific potential to contribute to sustainable technological development.**

2010

_BIO-INSPIRATION

In contrast to 'biomimetics' and 'bionics', bio-inspiration is a more encompassing terms that is defined as **using phenomena in biology to stimulate research in non-biologial science and technology** (Whitesides, 2015).

_NATURE-BASED SOLUTIONS

In the context of the European Union's R&I agenda for Nature-Based Solutions and Re-Naturing Cities, nature-based solutions to societal challenges have been defined as **cost-effective, sustainable, and multi-purpose solutions that are inspired or supported by nature, provide environmental, social, and economic benefits, and help build resilience** (European Commission, 2016).

PRESENT TECHNICAL RULES AND STANDARDS

The Association of German Engineers and International Organisation of Standardisation (ISO) have developed technical rules and standards with the intention of raising the profile of biomimetics and setting target on the harmonisation of terminology and technical language.

_BIOMIMETICS

In the ISO standard (2015), 'biomimetics' is defined as an '...**interdisciplinary cooperation of biology and technology or other fields of innovation with the goal of solving practical problems through the function analysis of biological systems, their abstraction into models, and the transfer into and application of these models to the solution.**'

_BIOMIMICRY_BIOMIMETISM

In the ISO standard (2015), 'biomimicry' and 'biomimetism' are both defined as '...**philosophy and interdisciplinary design approaches taking nature as a model to meet the challenges of sustainable development (social, environmental, and economic).**'

References
Speck, O., Speck, D., Horn, R., Gantner, J., & Sedlbauer, K. (2017). Biomimetic bio-inspired biomorph sustainable? An attempt to classify and clarify biology-derived technical developments. *Bioinspir*. Biomim. 12, 1-15.

03 | Miljøpunkt Østerbro

Team IILLAA
Author Lamiita Traista
Theme Empirical investigations
Date 09.02.21
Appendix 03
Page 1 of 2

Most of the insights have been gathered through an interview conducted on 09.02.21 with two representatives from Miljøpunkt Østerbro: Sara Jörn, the head of the organization, and Lama Juma, project manager in the organization.

Introduction to Miljøpunkt

Miljøpunkt is a self-owned foundation working towards urban sustainability which has local climate and environmental centres located in four districts in Copenhagen: Indre By & Christianshavn, Nørrebro, Amager and Østerbro. Each centre has its own decisional board and employees who work on developing projects both locally and across Miljøpunkt centres and districts in Copenhagen.

Organization's focus and approach to sustainability

Miljøpunkt is mainly focusing on cultivating sustainable behaviour in regards to the "[..] environment, climate change and nature and the many topics that come up under these three categories" (Lama, Miljøpunkt Østerbro), hence it's name. ('miljø' means 'environment' in Danish)

The organization has a bottom-up approach, where they try to influence citizens, organizations and businesses by offering inspiration and ideas of best practice that people can start using right away.

"We work towards changing behaviour and making people take responsibility." (Lama & Sara, Miljøpunkt Østerbro)

Among other things that have a large impact, such as reducing food waste and overconsumption, the aim is to develop a biodiversity strategy with the involvement of local citizens.

"People really want to green their city, they just don't know how." (Sara, Miljøpunkt Østerbro)

Perspective on nature and urban greening

Supporting wilderness and biodiversity - Nordhavnstippen [1]

Localised food production and climate adaptation [2]

Miljøpunkt advocates for wild nature, taking in consideration that "[..] sometimes nature in cities is a compromise of wilderness and biodiversity and then functions for human use" (Lama, Miljøpunkt Østerbro)

For the citizens in the neighbourhood, nature can mean very different things, from neat lawns for sports to intimate corners with flowers, but in Miljøpunkt's opinion, "[..] we have enough neat parks and need more areas that are untouched" (Lama, Miljøpunkt Østerbro)

Urban greening - a solution for making the neighbourhood more resilient to the effects of climate change, support biodiversity and human health, as well as sustainable food production and consumption.

Miljøpunkt supports the goals set by the Copenhagen municipality, such as reducing the private traffic by 25% and increasing the biodiversity in the city as a response to the mass extinction.

Vision for Østerbro

In Miljøpunkt's opinion, citizens and associations have the power of contributing with most of the changes needed towards a more sustainable city, apart from removing the asphalt.

These include:
- Green mobility and green energy
- Involving people in localized food production to reduce food waste
- Sustainable personal consumption
- Reusing resources
- Providing blue and green corridors for other species to live
- Incentives to reduce the number of cars etc.

Miljøpunkt's agency

"We are pragmatic as we are quite small and have very little influence on politics or any public spaces." (Lama, Miljøpunkt Østerbro)

Miljøpunkt is publicly founded - receives external founds and indirect support from the Copenhagen municipality (through the Local Committee Østerbro). The organization does not have access to public spaces - project proposals need to get permission from the Copenhagen municipality and the organization needs to make sure that it gets involved in the other urban greening projects.

"Sometimes we have to spend time knocking on doors and tell them to use us." (Sara, Miljøpunkt Østerbro)

Urban greening activities and collaborators

"We are not responsible for design of public spaces, so as far as design goes we're thinking in terms of projects and teaching – how to design meaningful things, that have people learn, grow, take responsibility and feel empowered to act on environmental and climate issues." (Lama, Miljøpunkt Østerbro)

In the case of the klimakvarteret development, Miljøpunkt was involved in citizen hearings and acted as a facilitator - making consensus between citizens who had different wishes and concerns.
The main challenge in the klimakvarteret projects was figuring out who owns the land and getting all the permissions for digging the land which was very time consuming.

Activities include engaging local citizens in developing the projects, making temporary art installations with them to show visions for specific areas and listen to wishes.

Miljøpunkt's current goal - building a green network where green associations, networks and active citizens can collaborate.

Main actors that Miljøpunkt collaborates with:
Nature preservation association, Østerbro Local committee, Nordhavn's Natursvenner, the Head of Denmark's Naturforening, Culture Centre Kildevæld

03 | Miljøpunkt Østerbro

Team IILLAA
Author Lamiita Traista
Theme Empirical investigations
Date 09.02.21
Appendix 03
Page 2 of 2

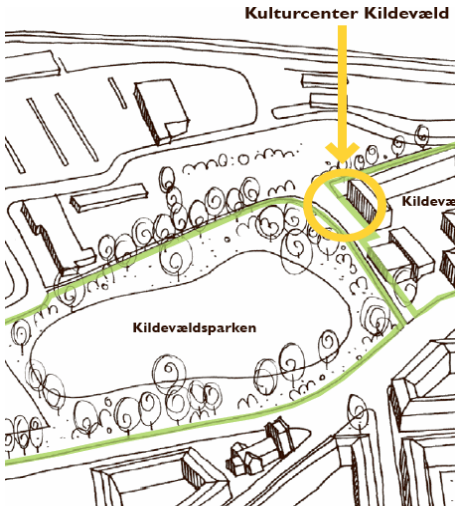
Urban greening projects

Sidewalk or street gardens inspired from Østerbro Gadehaver [3][4]

Østerbro Gadehaver is a community and network who took initiative of planting street gardens in Inner Østerbro together with the local communities. Citizens can even chose to 'adopt' an area and make it green.

A similar concept will be done by Miljøpunkt for greening Outer Østerbro.

Green art project in Kildevældsparken [5]



Kulturcenter Kildevæld is making an art installation in Kildevældsparken to inspire urban greening and gardening, after which the momentum will be used to spread more urban nature in the area.
Main collaborator: Thomas Dambo, artist known for its sculptures around Copenhagen built from recycled materials to raise awareness. [6]

Written answers to interview questions - Lama Juma

Since the organization is named Miljøpunkt, are you mainly working with environmental issues?
Yes, the environment, climate change and nature and the many topics that comes up under these 3 categories.

What is Miljøpunkt's approach to sustainability? In what ways do you consider/envision/practice sustainability?
We work with influencing those we can, meaning mainly citizens, but also organisations and businesses. Our approach is to have a broad range of things to offer in terms of inspiration, practice and solutions that people can start using now. Voting is important to have politicians take care of systemic issues. But what can we do right now - without waiting for anyone – to improve the environment, slow climate change and make space for nature and biodiversity? We focus on what has a large impact (e.g.. Reducing food waste and overconsumption), things that are hands on for people new to this work (new parent events about avoiding toxic chemicals etc. in baby's things, food and clothes, trash collection, swap markets)

How are these concepts (Environment / Greening / Sustainability) put together in the context of Miljøpunkt?
We are pragmatic as we are quite small and have very little influence on politics or any public spaces. So we work with those who are ready to work with us, who wants us to teach, who want to improve their yard, their habits etc. And we also follow where the political focus is, because that gives us an option to fundraise for more activities.

Did Miljøpunkt use biomimicry as a design approach so far? What about other design approaches?
We are not responsible for design of public spaces, so as far as design goes we're thinking in terms of projects and teaching – how to design meaningful things, that have people learn, grow, take responsibility and feel empowered to act on environmental and climate issues.

How do you envision the neighbourhood? Is it something concrete that can be done/applied in the future?
Removing more asphalt and letting citizens adopt more small gardens. Help associations build more green roofs and have plants on their facades. All but removing asphalt can be done with any citizen and association who wants to. We want to start a project about light/darkness for biodiversity. And we expect Strandboulevarden to reflect more of the citizens wishes for the green stripe since they have been involved in a hearing we were part of.

What are the current activities that Miljøpunkt is promoting (in regard to urban greening in particular - what is greening a solution to)?
Kulturcenter Kildevæld is making a green art project in Kildevældsparken soon and following that we want to take that opportunity to spread more small gardens in the area. Sidewalk gardens or street gardens. Maybe a bit like Østerbro Gadehaver, but could also look and be run differently. It's a completely new project, so we just had 2 meetings.
We are part of Nordhavns Naturvenner, a network lobbying for a large nature park in Nordhavn.
Greening is a solution to many things: We promote greener cities for the sake of biodiversity, making the city ready for the large amounts of rains and sometimes draught due to climate change, green because the air gets cleaner, plants cool the cities, cities are more livable, asphalt must be removed to make space for greens and that means fewer cars and air pollution and more cycling and walking with is good for our health. Also – more green spaces provides an opportunity to grow a bit more food in cities with is a more sustainable consumption. A lot of easily perishable foods can grow where we are. (salads, cabbage, kale, herbs to name a few)

What are the expectations for the projects?
We hope to engage local citizens for the small gardens in outer Østerbro, and for the large project with Nordhavns Naturvenner, we hope they grant the park a much larger space than what is planned for now, so that we can have a large, coherent park with many different kinds of nature, both wild parts and more park like areas. (Access for disabled is important)

What is nature from your point of view?
Mostly space for things to be wild, but we do understand that sometimes nature in cities is a compromise of wilderness and biodiversity and then functions for human use. Like growing food or making things pretty. (Some don't find wild to be pretty, but it's changing, fortunately)

What is nature for the neighbourhood?
Very mixed! Some like wild, some like things being neat, some like large lawns for sports, others want corners, flowers, peace, quiet and being closer to animals. We feel we have enough neat parks and need more areas that are untouched.

Is Miljøpunkt actively involved in the solutions done as part of the klimakvarteret development?
Not as city-planners, but when there are citizen hearings about a project we are sometimes involved.

References
[1] Miljøpunkt Østerbro. (n.d.). Naturpark i Nordhavn | Miljøpunkt Østerbro. Retrieved from Miljøpunkt Østerbro website: https://miljopunktosterbro.dk/naturpark-i-nordhavn/
[2] Miljøpunkt Østerbro. (n.d.-a). Klimatilpasning på Østerbro | Miljøpunkt Østerbro. Retrieved from Miljøpunkt Østerbro website: https://miljopunktosterbro.dk/klimatilpasning-paa-oesterbro/
[3] Miljøpunkt Østerbro. (2021). Grønne fællesskaber på Østerbro | Miljøpunkt Østerbro. Retrieved from Miljøpunkt Østerbro website: https://miljopunktosterbro.dk/groenne-faellesskaber-paa-oesterbro/
[4] Østerbro Gadehaver. (n.d.). Østerbro Gadehaver. Retrieved February 9, 2021, from www.facebook.com website: https://www.facebook.com/gadehaver.2100
[5] Klimakvarter. (n.d.). Kulturcenter Kildevæld — Klimakvarter Østerbro. Retrieved from Klimakvarter website: https://klimakvarter.dk/en/projekt/kulturcenter-kildevaeld/
[6] Dambo, T. (2020). thomas dambo – recycle art activist. Retrieved February 9, 2021, from thomasdambo.com website: https://thomasdambo.com/

04 | Collaborators

Team IILLAA
Author Isabella Ursano
Theme Research
Date 17.05.21
Appendix 04
Page 1 of 1

This worksheet aims to describe the different actors involved in the current project. Here below is presented a brief description of each.

Miljøpunkt Østerbro

In Copenhagen, each district has designated actors for meeting the Agenda 21 goals, which aim to contribute to the city's sustainable development focusing on local implementation of solutions and the involvement of citizens. Usually, the Local Committees of each district are responsible for engaging citizens in working towards sustainable development. In communities like Østerbro, Miljøpunkt has taken over the responsibilities of the environment and the work on behalf of the Local Committee. Thus, Miljøpunkt Østerbro has been developing one-year plans that support the CPH Agenda 2021 Strategies, keeping a holistic view of all the related issues that have or may impact the environment (See Appendix 12). Moreover, Miljøpunkt Østerbro focuses on cultivating sustainable behaviour by involving citizens in transforming Østerbro toward a greener neighbourhood with more biodiversity. The organisation's general aim is to make Østerbro a greener neighbourhood by including people's role into play. By this means, Miljøpunkt is investigating how to influence organisations, businesses and mainly citizens. They are trying to give citizens a say in how and why they want to greener the area.

KulturØ

KulturØ is a network of institutions for motion, nature and culture in Østerbro, forming part of the City of Copenhagen's Culture and Leisure Administration (Københavns Kommunes Kultur og Fritidsforvaltning) (Kulturoesterbro, n.d.). KulturØ's vision is to create a city that lives and grows together with Copenhageners through literature, sports, music, and creativity (KulturØ web page). They organise and facilitate green activities and workshops regarding nature, food waste, biodiversity and urban greening (See Appendix 20). The main focus of KulturØ is to create "networks of greening" (Emilie - See Appendix 20) and try to add more value in terms of urban greening. Their current project is to build a community that facilitates the dialogue between culture and nature, and the network from it can grow and be citizen-driven.

Park Administrator

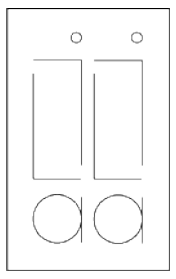
Within the municipality umbrella, the park administration plays a vital role in the green network. Signe Dragenberg, the park administrator of Ydre Østerbro, is in charge of the park's daily maintenance and development. The Udviklingsplan (the development plan of the Local Committee's vision for the district) is connected to the political strategies. It is considered the mindset, the central planning tool of possibilities and restrictions concerned with greening activities.

Biomimicry Hub Denmark

The Biomimicry Hub Denmark is a group dedicated to regenerative and sustainable methods. It has been founded by Lars Kiær, a professor at the Copenhagen University, Pernille Lethenborg owner of a consulting company called Biophilia, and Suzana Barbosa owner of her company Rewildnow focusing on nature-inspired personal and professional development. Biomimicry Hub Denmark works to inspire people from all walks of life to reconnect and play with nature's genius and weave nature-inspired design and business into the fabric of everyday life, fostering a future of regeneration and sustainability. The Hub wants to inspire people to learn from nature, reconnect with nature and pursue nature-inspired solutions for a healthy planet. We work to create a playful learning space and raise awareness of nature's incredible principles of adaptation, diversity, interconnectedness, patterns and self-organization. We help businesses, institutions and people from all walks of life to transform perception by looking through the lens of nature. Biomimicry Hub Denmark was established to create and nourish a network of biomimicry specialists and enthusiasts in the country. Their goal is to cooperate with the Biomimicry 3.8 and other biomimicry networks in Europe and globally. They put biomimicry in action by engaging in events, projects and teaching with focus on biomimicry and innovation inspired by nature. They arrange courses, talks and hand-on workshops in nature, and partner with national and local organizations with an interest in nature to promote principles of biomimicry, stimulate discussion and reconcile views of nature.

References
https://miljopunktosterbro.dk/
https://kulturoesterbro.kk.dk/
https://www.linkedin.com/company/biomimicrydenmark/

05 | Co-design



Team IILLAA
Author Isabella Ursano
Theme Research
Date 17.05.21
Appendix 05
Page 1 of 1

The intention of this worksheet aims to present co-design as a design approach. Co-design can be seen into two types of paradigms: one more "traditional" (design of) and one more close to compositionist design (design for) (Munthe-Kaas and Hoffmann, 2017). These are then divided into two sections of "design by" and "design with". In our project, we will use co-design in compositionist design rather than the "traditional" co-design.

Traditional (design of)

Is a design approach that involves participants, with different backgrounds, to participate in design activities: "is based on a belief that all people are creative and can contribute to design if provided with an appropriate setting and tools."

(Vaajakallio and Mattelmäki, 2014, p.63)

One of the primary goals of co-design is to combine the concept of 'making' as a method and as a tool, inside the practices of participation, giving people - which can be either designers or non-designers - the skill to 'make things' that can reflect their idea into objects, concerns, etc.

(Sanders et al., 2014, p.6).

Thus, this means allowing movement from past experiences to current situations until future scenarios, in which participants envision alternative solutions not yet existing.

(Vaajakallio and Mattelmäki, 2014, p.67)

It creates a safe setting where a group of people can experiment and share their ideas. Visualisations surround the setting, allowing the participants to experience and test their ideas. The outcome will be the merged observations, reflections, interpretations and expressions of the issues faced in the activity. Co-designers craft prototypes to shape their ideas into concrete objects to present, discuss and get feedback.

(Sanders et al., 2014)

These dynamics take place in a setting where: "...a co-constructed understanding about the context, people's experiences, potential designs and dreams [are] explored to assess their possible implications for organising co-design events among researchers, designers, users and other partners in diverse design contexts".

(Vaajakallio and Mattelmäki, 2014, p.63)

Halse (2008) describes co-design as a way of making the "familiar unfamiliar and vice versa", moving from simple to complex topics, typical in a community drama.

(Vaajakallio and Mattelmäki, 2014, p.54)

Compositionist design (design for)

Co-design as a compositionist programme of democratic design experiments differs from other design paradigms. As also outlined by Munthe-Kaas and Hoffmann's (2017), it refers to engagement, not aesthetics, thus it is design for and with, rather than design of.

(Munthe-Kaas and Hoffmann, 2017)

Focuses more on gathering together citizens and institutions.

(Munthe-Kaas and Hoffmann, 2017)

Is seen as a design laboratory, as a participant trying to "democratise democracy".

(Binder et al., 2015, p.153)

Traditional co-design is framed as a design approach that involves participants, with different backgrounds, to participate in design activities: "is based on a belief that all people are creative and can contribute to design if provided with an appropriate setting and tools."

(Vaajakallio and Mattelmäki, 2014, p.63)

Furthermore, Halse (2008) describes co-design as a way of making the "familiar unfamiliar and vice versa", moving from simple to complex topics, typical in a community drama close to the structure of a workshop. This way of using co-design will be applied merely in the staging phase, particularly in one step of the workshop (See Analysis Chapter XX).

(Vaajakallio and Mattelmäki, 2014, p.54)

Halse (2008) also states that these sessions are seen as "rituals". There is a transition from the daily practices to a magical setting. The location gets transformed into a performance space (e.g. positioning the furniture in a certain way, simulating a theatre). As Agger Eriksen (2012) points out, the physical location significantly influences the whole performance and can affect its outcome and dynamics.

(Vaajakallio and Mattelmäki, 2014, p.67)

Design paradims

(Munthe-Kaas and Hoffmann, 2017)

Design of - design by

In this section, we can argue that the traditional co-design lenses focus on an end product. For example, in traditional biomimicry (strong biomimicry), attention is towards the outcome rather than the whole process.

Design for - design by

In this paradigm, there is a change in the user's role. More credit is being given to the users, and their voice is being heard. However, it's still close to the traditional co-design standpoint.

Design of - design with

In this case, we can see how the traditional co-design, presented by Binder et al., focuses on the user's participation and how the designer's skills are being applied. Again, it is centred on the result rather than the development.

Design for - design with

Ultimately, this section presents the design paradigm most relative to what we aimed to practice. It focuses on the socio-technical network, and the role participants can have in the design phase more democratically, leaving them total freedom to experiment. Compositionist design stands in this sphere.

References

Kirsikka Vaajakallio & Tuuli Mattelmäki (2014) Design games in codesign: as a tool, a mindset and a structure, CoDesign, 10:1, 63-77, DOI: 10.1080/15710882.2014.881886
Munthe-Kaas, P., & Hoffmann, B. (2017). Democratic Design Experiments in Urban Planning: Navigational Practices and Compositionist Design. Co-Design, 13(4), 287–301
Thomas Binder, Eva Brandt, Pelle Ehn & Joachim Halse (2015) Democratic design experiments: between parliament and laboratory, CoDesign, 11:3-4, 152-165, DOI: 10.1080/15710882.2015.1081248
Elizabeth B.-N. Sanders & Pieter Jan Stappers (2014) Probes, toolkits and prototypes: three approaches to making in codesigning, CoDesign: International Journal of CoCreation in Design and the Arts, 10:1, 5-14, DOI: 10.1080/15710882.2014.888183

06 | Affinity Diagram

Team	IILLAA
Author	Isabella Ursano
Theme	Research
Date	31.05.21
Appendix	06
Page	1 of 4

Through an affinity diagram, this worksheet gathers all the quotes we ectracted from a large collection of research papers related to biomimciry literature. The affinity diagram is a method used for thematic analysis of a large number of ideas, by organising them based on their natural relationships (Tague, 2009). This tool helped us see most the overall considerations of biomimicry and how experts are talking about it in the literature. From this analysis, we brainstormed ideas, organised them into 9 categories based on their affinity in order to be able to better grasp the complex and plural issues, promises and implications inherent to biomimicry as a concept. We conducted this method in digital format by using of miro, a digital platform for collaboration.

References

Aanuoluwapo, O. (2017). Biomimetic Strategies for Climate Change Mitigation in the Built Environment. Energy Procedia, 105, 3868–3875

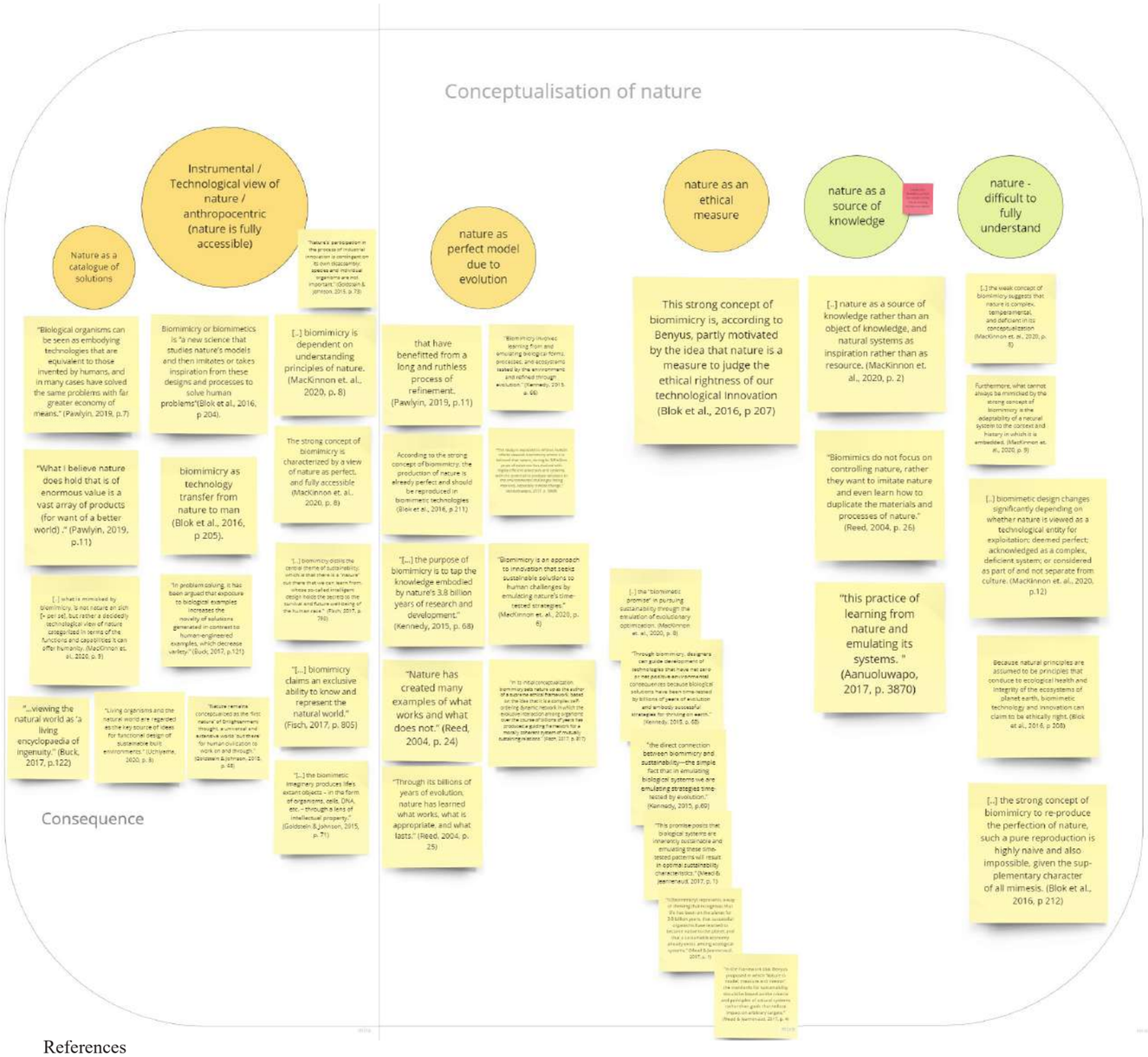
Aziz, M. S. (2016). Biomimicry as an approach for bio-inspired structure with the aid of computation. Alexandria Engineering Journal, 55(1), 707-714.

Fisch, M. (2017). The Nature of Biomimicry: Toward a Novel Technological Culture. Science, Technology, & Human Values, 42(5), 795–821.

Blok, V., & Gremmen, B. (2016). Ecological Innovation: Biomimicry as a New Way of Thinking and Acting Ecologically. Journal of Agricultural & Environmental Ethics, 29(2), 203–217.

06 | Affinity Diagram

Team	IILLAA
Author	Isabella Ursano
Theme	Research
Date	31.05.21
Appendix	06
Page	2 of 4



References

Buck, N. T. (2017). The Art of Imitating Life: The Potential Contribution of Biomimicry in Shaping the Future of Our Cities. Environment and Planning B: Urban Analytics and City Science 2017, 44(1), 120–140.

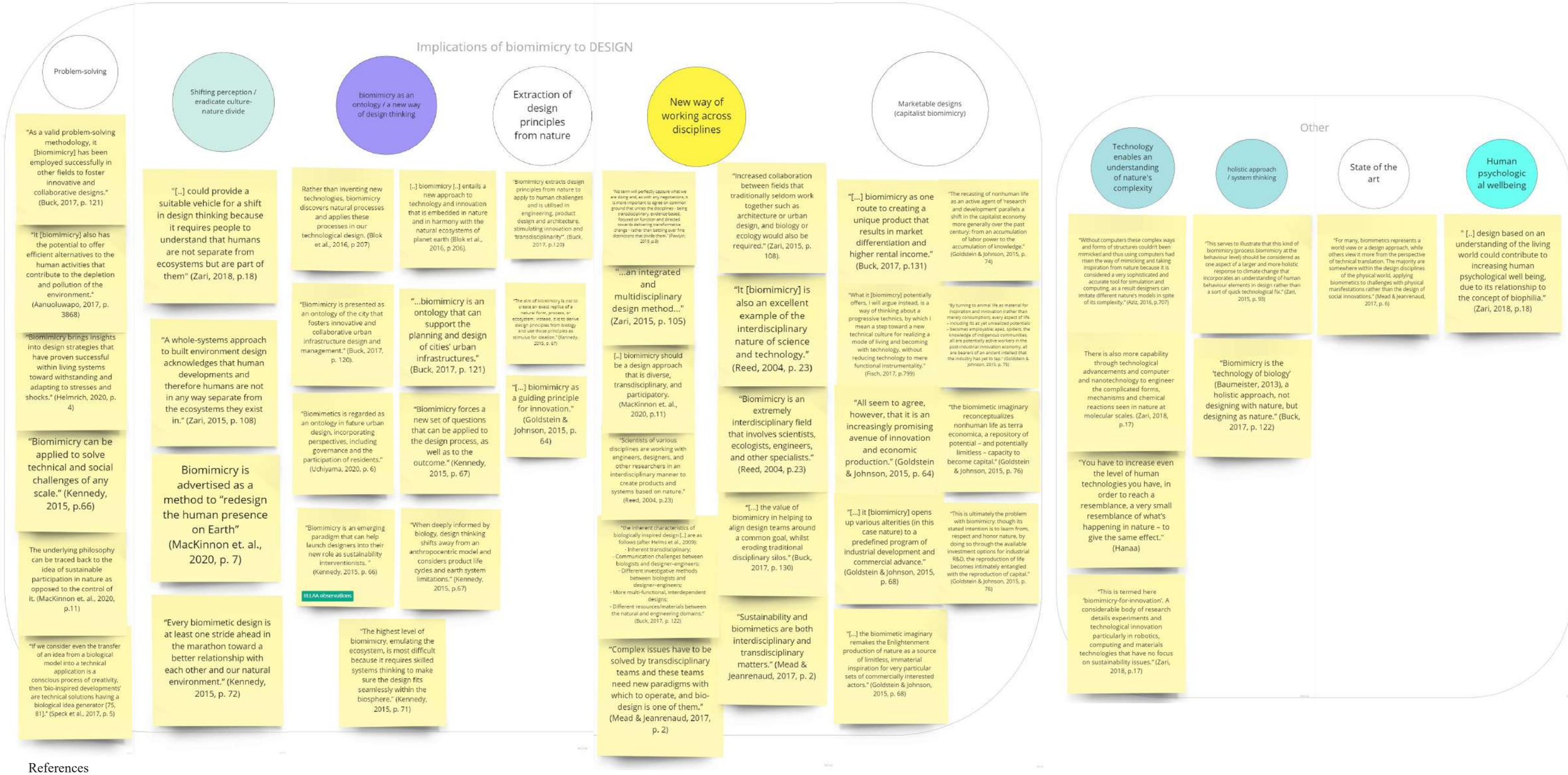
Goldstein, J., & Johnson, E. (2015). Biomimicry: New Natures, New Enclosures. Theory, Culture & Society, 32(1), 61–81.

Helmrich, C. et al. (2020). Using Biomimicry to Support Resilient Infrastructure Design. Earth's Future, 8(12), 1-18.

Kennedy, E. et al. (2015). Biomimicry: A Path to Sustainable Innovation. Design Issues, 31(3), 66–73.

06 | Affinity Diagram

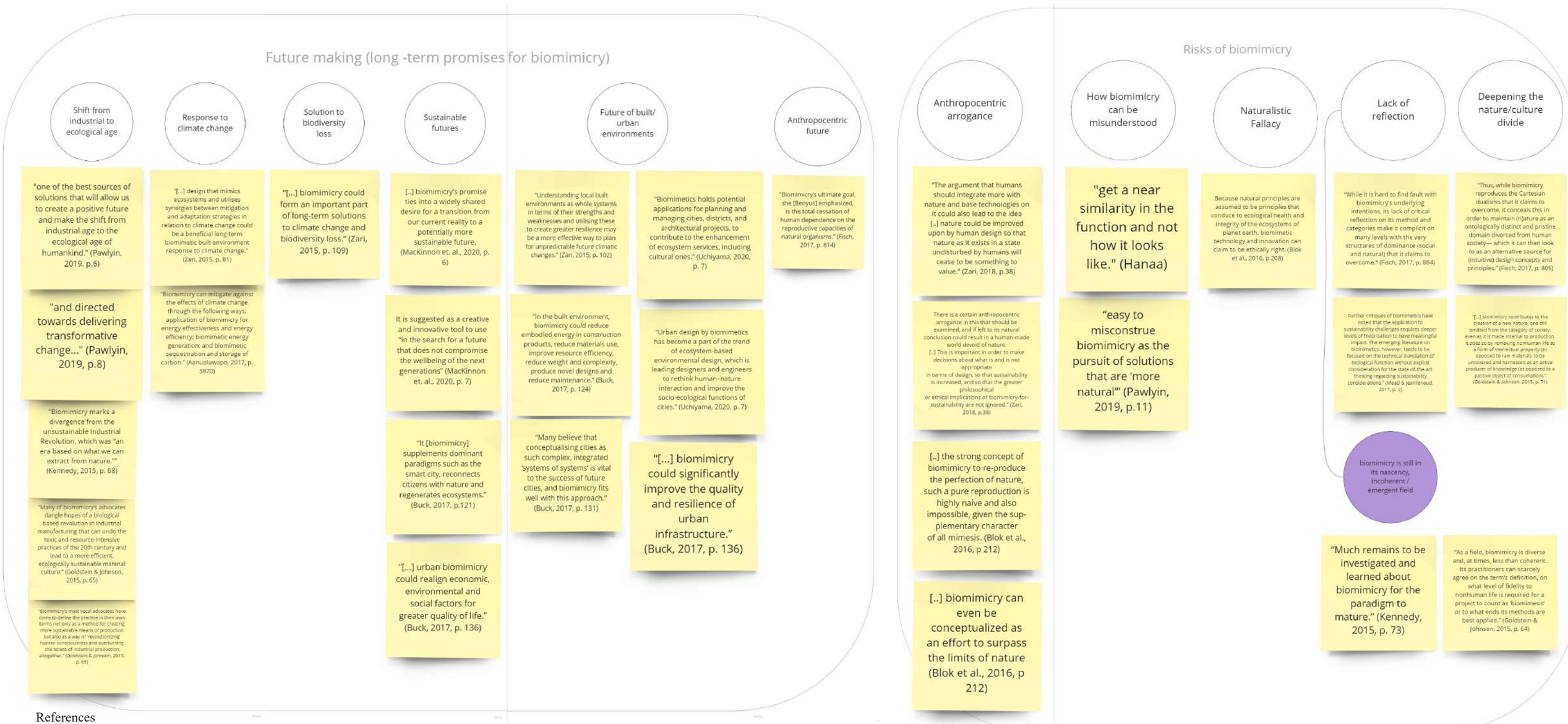
Team IILLAA
Author Isabella Ursano
Theme Research
Date 31.05.21
Appendix 06
Page 3 of 4



References
MacKinnon, R., Oomen, J., & Pedersen Zari, M. (2020). Promises and Presuppositions of Biomimicry. Biomimetics (Basel, Switzerland), 5(3), 33–47.
Mead, T. & Jeanrenaud, S. (2017). The Elephant in the Room: Biomimetics and Sustainability? Bioinspired, Biomimetic and Nanobiomaterials, 1-9.
Pawlyn, M. (2019). Biomimicry in architecture. Routledge.
Pedersen Zari, M., & Hecht, K. (2020). Biomimicry for regenerative built environments: Mapping design strategies for producing ecosystem services. Biomimetics, 5(2), 18.

06 | Affinity Diagram

Team IILLAA
Author Isabella Ursano
Theme Research
Date 31.05.21
Appendix 06
Page 4 of 4



References

Pedersen Zari, M. (2015). Can Biomimicry Be a Useful Tool for Design for Climate Change Adaptation and Mitigation? In Biotechnologies and Biomimetics for Civil Engineering. Springer International Publishing, 81–113.

Pedersen Zari, M. (2018). Regenerative Urban Design and Ecosystem Biomimicry, 1st ed. Routledge: Abingdon-on-Thames, UK.

Reed, P. (2004). A Paradigm Shift: Biomimicry. The Technology Teacher, 63(4), 23–27.

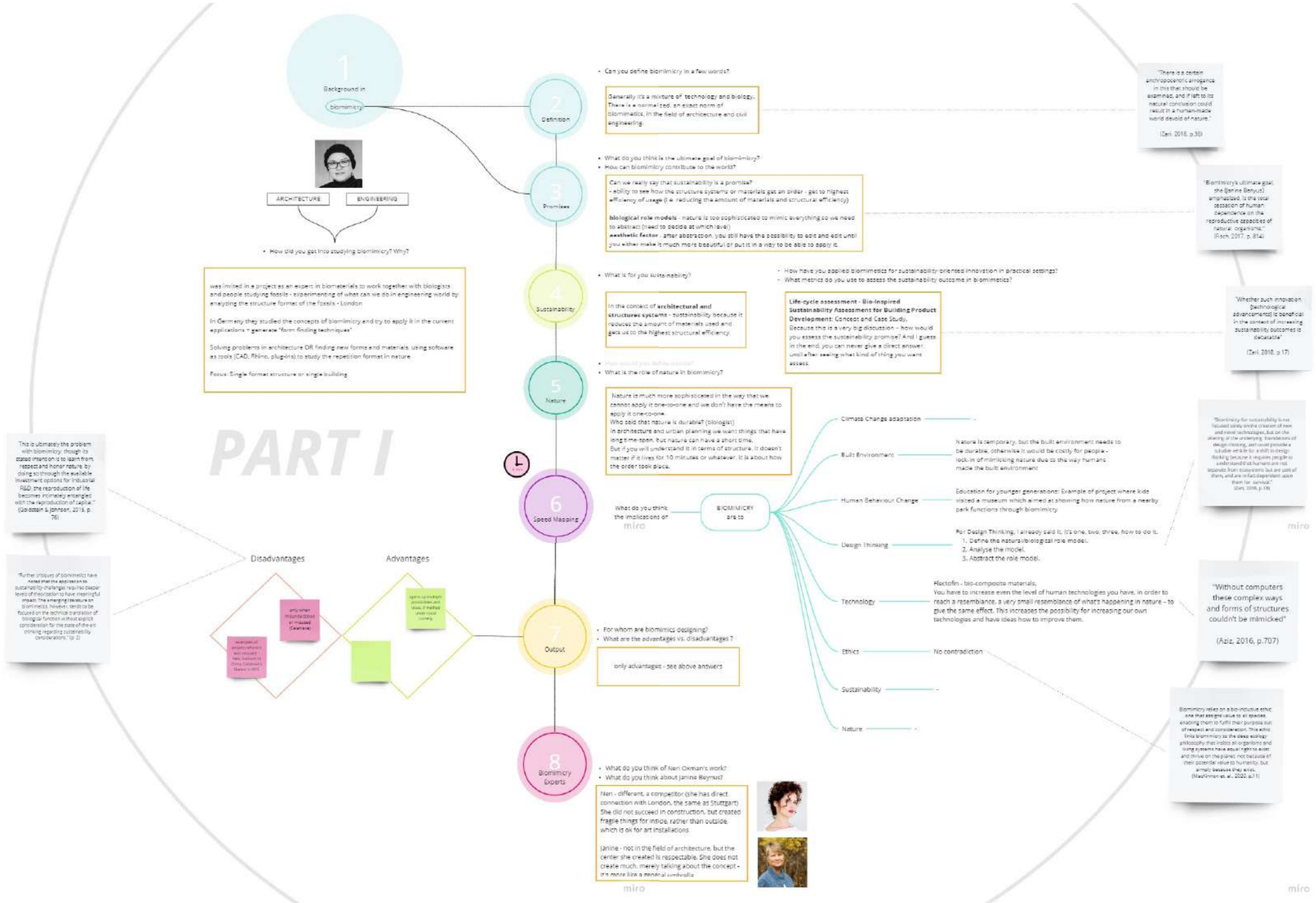
Uchiyama, B. (2020). Application of Biomimetics to Architectural and Urban Design: A Review across Scales. Sustainability (Basel, Switzerland), 12(9813). pp. 1-15.

Wahl, D.C. (2006). Bionics vs. Biomimicry: From Control of Nature to Sustainable Participation in Nature. In Design and Nature III: Comparing Design in Nature with Science and Engineering (Brebbia CA (ed.)). WIT Press, Southampton, UK, WIT Transactions on Ecology and the Environment, vol. 87, 289–298

07 | Biomimicry Workshop with Hanaa Dahy

Team	IILLAA
Author	Isabella Ursano
Theme	Part I
Date	04.03.21
Appendix	07
Page	1 of 6

The workshop has been designed on an online platform “Miro”. We selected one of our supervisors, Arch. Hanaa Dahy, as a biomimicry expert in our research and as the only participant. We played the role of the facilitators. The workshop was structured in Part I and II: the former was structured as an interview with questions regarding Biomimicry about sustainability, nature and urbanism; the latter, was structured as an interactive exercise by applying biomimicry developed from a sustainable designer perspective. The aim was to get a better understanding of biomimicry from an expert point of view. We collected insights to get more inspiration to further argue our understanding, definition, choice, application and approach to the discipline, having in mind to define our end goal in terms of sustainability.



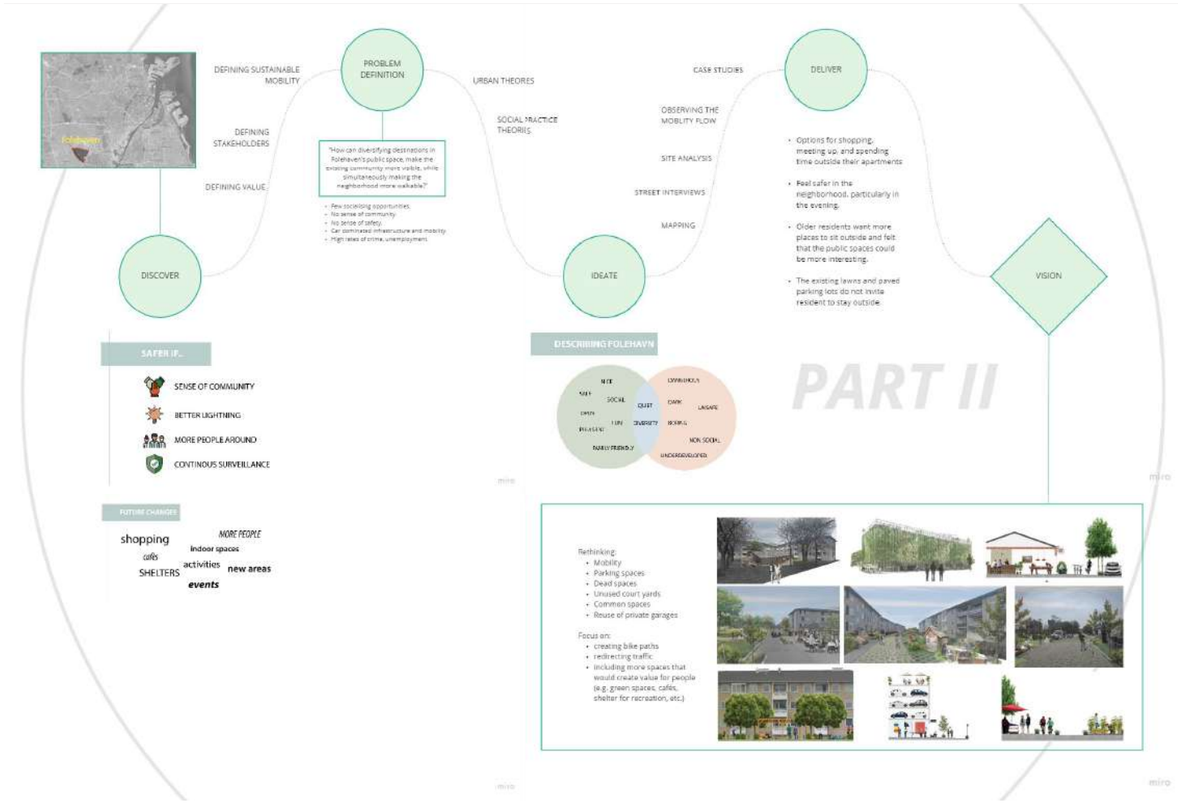
Part I - discussion and reflection about the following topics

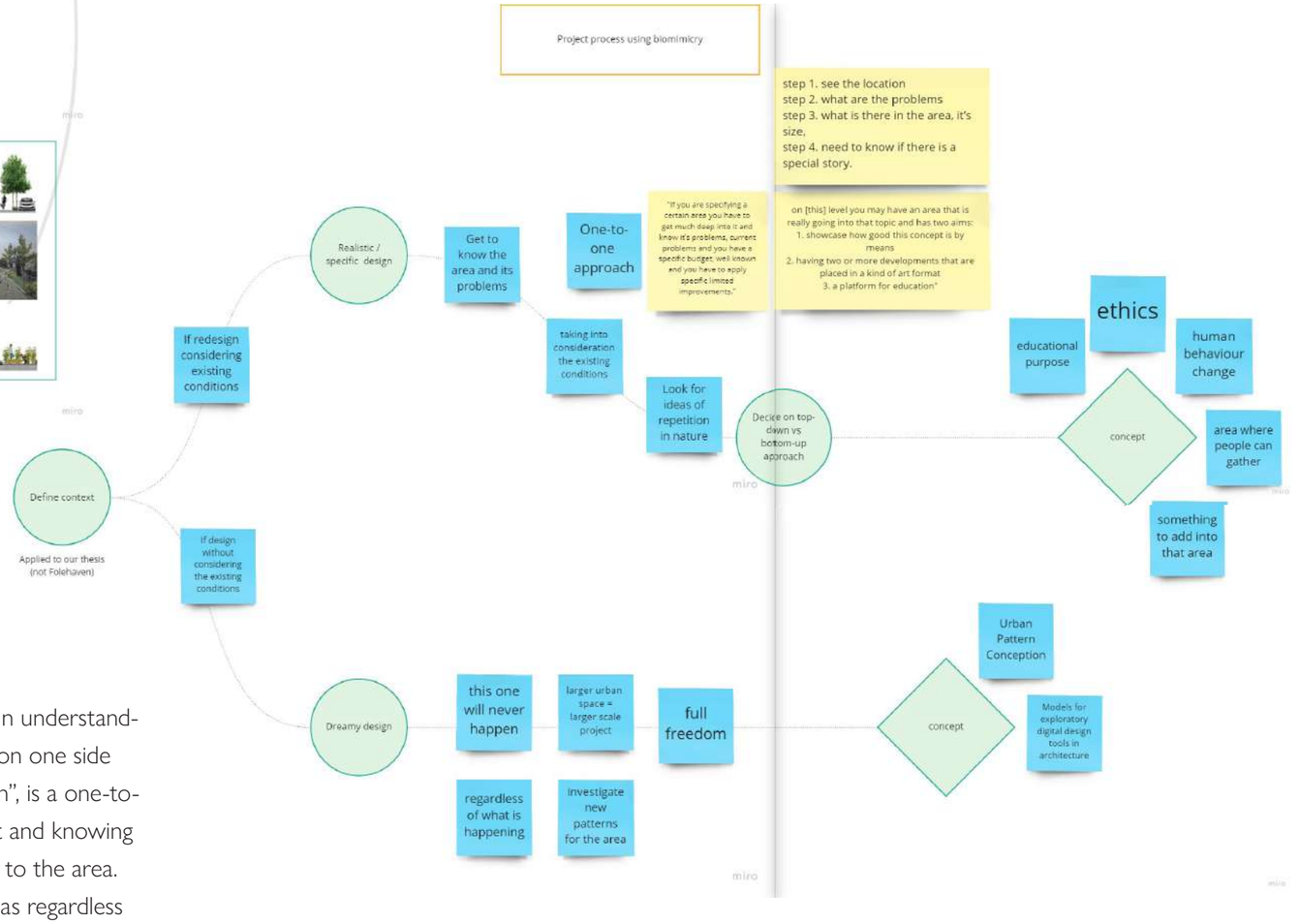
/ We asked a brief introduction of the candidate and why biomimicry became part of her studies.
/ The definition of biomimicry
/ The ultimate goal of biomimicry and how it can contribute the world
/ Nature and it's role in biomimicry
/ The application of biomimicry in Hanaa's previous projects/practical settings
/ Biomimicry in relation to sustainability - in an architectural context
/ Implications of biomimicry to different areas
/ TThe output of biomimicry and to whom is designed
/ The advantages and disadvantages
/ The role of Neri Oxman and Janine Beynus as biomimicry experts

References
https://miro.com/app/board/o9J_lTbsthU=/

07 | Biomimicry Workshop with Hanaa Dahy

Team IILLAA
Author Isabella Ursano
Theme Part II
Date 04.03.21
Appendix 07
Page 2 of 6





Part II - scenario workshop

/ Presentation of a project developed from a sustainable designer perspective

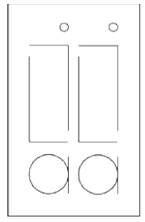
/ Imagining the same project but approached using biomimicry

/ Discussion on possible differences of the end result

Outcome

After presenting the project done during the first semester of the current master course, Hanaa guided us in understanding the process of applying biomimicry in a similar context. First of all, it is necessary to define the context: on one side redesigning considering the existing conditions and the other one without. The latter, "realistic/specific design", is a one-to-one approach, taking into considerations the real problems of the selected area, getting much deeper into it and knowing it's problems, applying specifically limited improvements, by finally presenting a concept that adds something to the area. The former, is a more "ideal design", were we as designer have the full freedom to navigate and propose ideas regardless of what is happening in the context.

07 | Biomimicry Workshop with Hanaa Dahy



Team IILLAA
Author Isabella Ursano
Theme Transcription of Workshop
Date 04.03.21
Appendix 07

Here below is the transcription of the workshop - which we kindly asked Hanaa to be recorded at the begging of the session.

Part II

1. How did you get into studying biomimicry? Why?

Hanna: "This is more of a personal question - it was due to a project where I was invited to take part as an expert in biomaterials.[..] I had to work together with biologists and people studying fossils [..] so we were experimenting what we can do in the engineering world by analysing the structure format of the fossils. [..] So this was in London". "The reason for using biomimetics in my work was to solve problems in architecture or finding new forms and materials.[..] I also use tools such as CAD, Rhino and different plug-ins to study the repetition format in nature." Focus: single format structure or single building, not a network or urban design

2. Can you define biomimicry in a few words?

Hanna: "Generally it's a mixture of technology and biology and there are actually also at the moment definitions that are accredited, definitions that are according to a norm. [..] There is a normalized, an exact norm of biomimetics, in the field of architecture and civil engineering."

Lamiita: What do you think of the quote: "There is a certain anthropocentric arrogance in this that should be examined, and if left to its natural conclusion could result in a human-made world devoid of nature." (Zari, 2018, p.38)

Hanna: "I don't like this way of .. what should I say, provocative or what is this? This is not scientific, so if we are in a general discussion we can say whatever we want and I think this could be in any unofficial conversation, but to have it as a reference for a definition, no way, no way. I am extra careful to give you the exact statement, I was thinking of a norm and then this is like.."

"Yeah because here we are trying to apply a specific design method. If we apply it, these wordings are not really scientific. For many designers, and some (laughs) philosophers, they talk many many words. I was one of them. But when we talk scientifically, this is something else. We need to be clear. When I am talking with my students, I talk about many things, but when I am writing a paper, a scientific paper, no, this doesn't belong here."

Lamiita: Well, for us as sustainable designers it is relevant to take all perspectives into account.

Hanna: "Yes, but what you are trying here to get is a definition to start with, right? So it is hard to get, I mean here he is so suspicious about the concept itself. The words, I don't know the author, but the wording is not helpful in my opinion."

3. What do you think is the ultimate goal of biomimicry? How can biomimicry contribute to the world?

Hanna: "The goal of biomimicry is sustainability or to reach sustainability. In the context of how I worked with biomimicry myself, was to see how the structure system or the materials gets an order. This gets us to the highest efficiency of usage."

"So when I applied it in person, I applied it in the sense of a building system or a material system integrated in a way that we reduce as much as possible the amount of materials used.[..] It helped us to form-find. What is the form finding? It's a design: how to design the structure system of yours in a new ordered way. And this leads to sustainability because it reduces the amount of materials used and gets us to the highest structural efficiency."

"This is in the context of architectural and structures systems. Because in the urban that would be something else, because other things will be, like the air flow, noise reduction. You have to select the correct biological role model. [..] either a specific system in nature, or an animal or the back of an animal, the wing of a specific bug."

"But when we try to apply it [the natural phenomena], we apply it with the kind of technologies that we have. Nature is much more sophisticated in the way that we cannot apply it one-to-one and we don't have the means to apply it one-to-one. It has to be abstracted. So always that is the first thing: you abstract the biological role model. [..] You have to define first what is the biological role model, [..] what is the kind of phenomena that you would like to study because it will solve a problem to you or what kind of phenomena that is so amazing that exists in nature but not yet into our world. Those are the two ways."

"Then you abstract the biological model. Abstracting at which level? That is the question. There is structural abstraction, you abstract it when we are talking about a specific structural system."

"But also the aesthetic factor. Sometimes you abstract something, but from a designer point of view, it doesn't look good. [..] So there is a user perspective of this concept of this design strategy and then the human factor comes in. You still have the possibility to edit and edit until you either make it much more beautiful, because after it has been abstracted it lost many things, or you put it in a way that you can apply it. Because at the end we are nothing compared to the sophisticated things already existing in nature."

4. What is for you sustainability? High efficiency - see question 3

How have you applied biomimetics for sustainability-oriented innovation in practical settings? What metrics do you use to assess the sustainability outcome in biomimetics?

Lazaara: As you were saying in the beginning, before we began with the Miro board, the kind of metrics that you use in a project that would…

Hanaa: I can't see…I have to really find a way to follow where are you pointing? Who is pointing?...

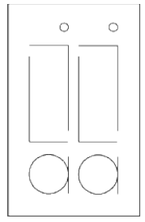
Lazaara: Number 4 that says Sustainability, the second box - What metrics do you use to assess the sustainability of a project?

Hanaa: I will tell you. There is actually a publication called Bio-Inspired Assessment…I was co-author in it. But it was linked to this project I am telling you about and it was really interesting and I will tell you why. Because it was a cooperation between a building physics engineer, who was using a certain program they had invented for the Life Cycle Assessment, and myself and a biologist. So, the three of us. It's called Bio-Inspired Sustainability Assessment for Building Product Development: Concept and Case Study. And the building product was this a Bio-flexi one, I think it's relatively long paper, and really the people who were there they were from all kinds of ..yes… Horn was the leader of the Fraunhofer Institute in Building Physics.

Lazaara: Would it depend on each project what kind of sustainability metrics you would use? Or is it more standardized?

Hanaa: They were trying in this project of Caesar one (?)…let me open Caesar one (?) Because this is a very big discussion – how would you assess the sustainability promise? And I guess in the end, you can never give a direct answer, until after seeing what kind of thing you want assess. And this is logic, because we want to assess something that is like this publication I sent you now, it is a very straight forward thing that is relatively easy to assess. But they tried in this project, I will give you a link, that was aiming, only at that point, aiming to assess, to find a line to assess. Let me send you that… This

07 | Biomimicry Workshop with Hanaa Dahy



promise. And it is really very sophisticated to give a direct direction how to assess that. They were trying here to see what kind of mimetics […?], is this really solving technical problems, but also giving a better solution in the sense of Life Cycle and so on.

5. How would you define nature? What is the role of nature in biomimicry?

Hanaa: "One of the things about nature - who said that nature is durable? [..] I am copying the words of one of the biologists who was in one of my teams. [..] So she was saying in nature actually you have the things decaying, and then you have the seeds to live back again. Because in architecture we want things that live. And not in architecture only, in urban planning. You're making a context for the city where things must live for the next 200 years, if you're talking about infrastructure. [..] You are planning for longer years. So if you are taking a biological role model that already has a very short time, how will this happen? That's a philosophy, but if you will understand it in terms of structure, it doesn't matter if it lives for 10 minutes or whatever, it is about how the order took place."

6. What do you think the implications of biomimicry are to ..

Lazaara: I'm going to jump to number six, the speed mapping. What kind of implications does biomimicry have to, for example, climate change adaptation or mitigation?

Hanaa: I'm trying to read all aspects. Some can directly be answered and some not, because it's very general. For Design Thinking, I already said it, it's one, two, three, how to do it. It is very nice when it comes to finding new concepts within Design Thinking, either on a smaller format, like a product, or a whole building, or a bigger city – so that was answered. For technology, I also told you about the conflicts we had, when we tried to apply it. We had to find a trick to apply it. I will give a direct example. I already explained to you this louver, the sunshades

Isabella: The Flectofin.

Hanaa: Yes, in order to reach something, some kind of… what is it called… there is a usage of fiber-enforced composites on that. You know the fiber-enforced composites? Fibers and a matrix and they get combined and they have another property that is not existing when fibers are alone, or when the glue or this binder is alone – that's the general concept of bio-composites, of composites generally. They are hybrid materials that are composed of at least two components – one is a fiber and one is a glue, kind of. And the reason why we are doing this, we are trying here to replace very thick materials and make exactly the fine properties. That's the general idea.

And when they wanted to apply the Flectofin or they wanted to take the concept apply it in a product form, they had to go much deeper in understanding materials in our technical norms, in our technical human level, and develop on that in order to reach, to match with the kind of complexity happening in nature. So, they applied so many ways to make something called… I can't remember the name…there is a scientific wording for materials when you're differentiating the… yes, functional-graded materials. Functional-graded materials, because everything in nature is functional graded. Your skin is functional graded. It's the same, but here [pointing to her hand] the grading of it and the density and its touching and everything is different than this one [pointing to her face] and is different that the one on the back. And the reason is the differentiation in the function in each case. It's graded, at each level it's graded.

And so is this Flectofin, it has to be graded so that there is push from one side that leads to a movement on the other side. And this comes only when you have a gradation. And this gets us to the technology, then. You have to increase even the level of human technologies you have, in order to reach a resemblance, a very small resemblance of what's happening in nature – to give the same effect. And in Flectofin, it was this opening and closing, but of course different materials, different thing.

The ethics, I find no contradiction. We're not using something that uh… that has to… I mean, there is no contradiction of applying biomimetics.

Lazaara: And if it adds something, I think because for example here [pointing to quote] and we've read it a lot, that biomimicry kind of enforces a bio-inclusive ethic. So not only is there no contradiction, but actually almost improves our ethic, because it makes us value nature in an intrinsic way.

Hanaa: Very very true. And from my personal experience even, you look really differently at things, you look to an ant, or … I mean those things that exist all over and most probably you would be looking at it anyway as a kid, very inspired, but you have another level of understanding how it works and even the leaves. Because there are certain leaves that does not allow water or any kind of dirt to stick on it and this was very helpful to understand specific kinds of paints that are important for hospitals to maintain the hygiene, so the main concept of surface. So this increases the possibility for increasing our own technologies and have ideas how to improve them. And on the same side, it gets us really appreciating more what's happening in nature.

Lazaara: And do you think this could be… often we've read about biomimicry as a kind of shift, in different respects, it could be in an innovative sense, in a technological sense or design thinking sense, but also kind of in an ethical sense, where biomimicry can be used as a tool to help us eliminate the distinction between humans and nature.

Hanaa: Yes, very true. I have to say it, And also I want to say that within this project there was a museum that was filled with the outcome of this research and it was given in two ways also that kids would also understand. And there were very nice formats, thank god it was before all this epidemic. So it was very well-visited and thousands and thousands of people came and visited them, including kids. And the way kids reacted to that was amazing. It was next to a very big park, and the kids were linking what's happening in that museum with that park. It was a part of a visiting school trip organized to connect with what's going on in the park, what's happening with the insects and so on, and what the researchers aimed to do and succeeded in doing. It was really a very good educational point of view, so when it comes to ethics, a lot can be said.

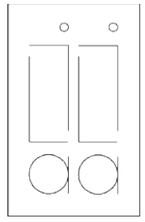
Lazaara: Human-behaviour change.

Hanaa: Yeah, I said that a couple of times. Like the way you see things, the way you get inspired, educational format. Starting, I mean, as a kid, if I had something like this as a kid. I don't know if I would take the same career path, or yes the same but maybe inspired in a much further deeper. It's more amazing than one can imagine. And it's satisfying. It's very satisfying.

By the way, I want to say something about the climate change adaptation and the built environment. Because also, those two points were definitely deeply investigated and we talked about it a lot. For instance, about the built environment and whether it is always necessary to build durable – something that would live 200 years or 300. Should we do like nature, should we make all building temporary or, at least, all buildings that are not in the housing format, that was one of the questions. And only of course again because of costs, because the kinds of technologies we have, at the moment, cannot hold that.

We are not… we cannot do as luxurious as it happens in nature – that the cycle is shorter and it goes on and closes quickly and generates itself on its

07 | Biomimicry Workshop with Hanaa Dahy



own, except with the destruction we make, that it cannot generate quickly so it gets extinct. That's the problem in nature and the problem of its sustainability has to do with the human behaviour and does not have to do with nature itself.

So that was something that when it comes to this…it was a very big conversation. And because of corona also it was a discussion now that we need so many temporary building that have to be built quickly and had to be collected back again quickly and stored and built back again, like the hospitals or all the areas that you need to stay in queues because of the corona and so on. And of course, unfortunately, it is known that corona is only start, it is the era of having all kinds of infections and so on, unfortunately it's just the start.

So all of those, the way we make building, we differ in having temporary buildings. The importance of that is much higher now, so it gets us to the point of understanding how the interlocking takes place. If it's a temporary building, you have to try to reduce the screws and to make holes and make a screw and so on. You adapt what's happening in nature about having certain anchoring or things that get into each other that way. There are so many things in nature happening like that, and from that we can adapt a lot of things.

7. Output - disadvantages of biomimicry

Lazaara: Disadvantages to using biomimicry as a methodology.

Hanaa: I only see this disadvantages when you misuse, when you misunderstand it. I only see disadvantages in that. I don't see any disadvantages actually. If you understand it correctly, and there are millions and millions of ideas to pick. Because, I will give you an example, before I forget. There is this nest stadium in China. The national stadium, it is taken as an icon, and because it is something easy to see. It looks amazing, I have no problem with that. But please don't call it a nest – a bird nest and that you are making it after the biomimetics of a bird's nest.

A bird would cry when it sees that. It's full of steel, and you are making the intersections very… I mean it looks amazing, I have no problem , but please don't say it is biomimetics. So that is a false example of biomimetics, you can never take it. And therefore it can never be promising anything. It is not promising sustainability for sure. It looks perfect, but has nothing to do with sustainability in the way we are talking about it.

And there is also the architect Santiago Calatrava. And he is really brilliant and I studied as a student his work. Others say his work is biomimetics, but his work is not biomimetics. The one in New York, I think, yes. This [link] I know that he didn't say that he is making this for biomimetics. It looks brilliant, but it has nothing to do with biomimetics. Those two examples, the nest and this are exactly where you know this has nothing to do with biomimetics. And this I understood well, only because I worked in this project really very deep with all the crew who are working from several perspectives and biologists and fossil experts and so on.

Isa: So, it was mainly used for an aesthetic approach.

Hanaa: Yes any designers can do really anything. And if he finds users who are happy with it, they are the ones who will pay.

But if you want to make something still amazing but you know exactly the order of things where they need to be and you have increased your own technology you have. It was so often we had to improve something we have so that we can just get a near similarity in the function and not how it looks like.

8. Biomimicry experts - Neri vs Jenine

Isa: Neri vs. Jenine

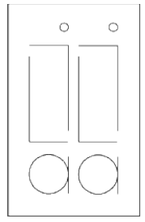
Hanaa: Neri is working in parallel. She started before me and has also a group. But the way she works is very different from mine. I know both. But Neri I know much more, because she is a kind of competitor. But she visited our school, earlier. I haven't met her in person, I wasn't there at that time. But I know she has a very direct connection with London, which we have also. She started studying medicine and that had an influence on her. And then she started working on additive manufacturing techniques and she wanted to try to combine both.

The point is that the way she is applying it, as far as I've seen, she has not succeeded in applying it in construction for real. So she takes more in the concept of product design, smaller products or art pieces. She has cooperation with a team in material sciences and a team in fabrication. So the three points I am always talking about – the design, the fabrication and the material. The kind of materials she's applying, she's trying mostly to use the bio-materials that are taken directly from the shells from shrimps, or from grass. But those are mostly fully either soluble in water or completely fragile to be placed in outside spaces, or even inside spaces.

There are so many things that can mold and cannot take humidity for so long. So those are the main problems of her work – when it comes to durability and applying it to architecture. Because I am an architect I am always reflecting on that. But in other perspectives or in other fields, this may be fully ok. For artists, this is brilliant, for specific smaller products, that's really good enough.

And the other lady [Janine] I haven't gone much deep into that because she is not an architect, as far as I know. But the centre that she has created is really respectable, and by the way this center is the one who gave the prize to this student that I had before that collects the humidity of the fog. It's [the centre] like a general umbrella. But Neri has a very specific direction of really making objects. While the other lady is trying to make a centralized idea of giving those kinds of concepts to the external users for educational purposes.

07 | Biomimicry Workshop with Hanaa Dahy



Team IILLAA
Author Isabella Ursano
Theme Transcription of Workshop
Date 04.03.21
Appendix 07
Page 6 of 6

Part II

Isa: describing Folehavn Project

Hanaa: I will send you some links about public spaces and how to create public spaces, people for people and getting activities and so on and there are very nice ideas here and there are things related to harvesting. So this is the big theme. Are you gonna apply it for the whole location because it's relatively big and then it gets us to the point, also one of the things that I want to know: are you thinking of something that you are making a pure completely design that is different than the case that is happening already or are you going to take what's going on in the moment or how the distribution of spaces is actually taking place and you are trying to reduce as much as possible an overall redesign? I don't know the strategy because this will differ.

If we are talking about a re-design than you have much more freedom and if we are talking about something that you are just making here a kind of a study but you know in advance that it will never happen. So I don't know what your direction is. Are you making pure design ? Are you making something that can be really done and you are in connection with people from the municipality or the company you have talked about last time and you are aiming really to at least get to a certain part or points so that your master thesis is done one to one or are you working regardless of what's happening ? I don't know what your direction is.

If we take the point of regardless of what is happening, on the concept of working on larger urban spaces and how to derive specific codes of repetitions within the flow of the urban pattern on a much larger scale.
If we are talking about redesign but not completely but rather taking into consideration the situation of the existing conditions, then you have to reduce your area anyway because you will not be able to get to this level of analysis on such a large location.

And then on that level even if you apply biomimetics in I don't know what to say, just a structure of a path that kids could get to learn a bit about this concept and integrated with teaching concept for the new generations, then you have included the ethical point and the human behaviour change point. So it affects the people as well by having specific means for that. Like having an area where people can gather and can get information about that topic and can get a point of or remark or something to add into that area. So it depends, you need to know if you are really aiming for a full re-design.

When I was an architect student I knew that each project is not going to happen. In the office is different. So if you are orienting yourself in your thesis in cooperation already with a company that is really existing and really wants to solve something you need to reduce the area. I don't know how many km2 or how many m2 is your area.

So generally speaking, to help you out as good as possible as I can to shorten this headache where, how and so on, if you are making the redesign for the whole place, for a large spectrum, and this is not going to be applied, we then have full freedom of dreaming then you can apply these concepts of re-patterning or making new patterns for the area depending on codes you can get or ideas of repetition. You can get for a certain reason. For instance, if the place has a very high wind flow and you want to reduce it you can look up how you can reduce this through the repetition of a certain sculpture or certain densify the pattern differently so that you would make this function and differentiation depending on this repetition. That's one for instance.

If you are specifying a certain area you have to get much deep into it and know it's problems, current problems and you have a specific budget, well known and you have to apply specific limited improvements, that's a whole different story and still on that level you may have an area that Is really going into that topic and has two aims: showcase how good this concept is by means of having 2 or 3 or 4 developments that are placed in a kind of art format and a platform for education. So there are different ways of handling your project thesis, how can you integrate biomimicry in it, it can have different scales but it depends on the real condition in which frame you want to put yourself in.

1. Specific
2. Dreamy

Lamiita: On or the other and then look into some specifics that are in nature or how would you approach this

Hanaa: I would see the location, what are the problems that are there, similarly you have to understand what is there in the area, it's size, what size we are talking about , and you need to know if there is a special story. For instance there are areas in certain cities that are well known for having storms in a specific time of the year and there is always a problem and it affects the users of that district or that area negatively . There are so many areas all around the world and in bigger cities like Cph and others – there is something specific that causes a problem there (in osterbro for example) studying existing conditions that has to be integrated anyway regardless if you are going to day dream and make all what you want and you know it won't be applied or you are designing for reality. Regardless of that you have to get to all these situations there and know exactly what is going on and what are the problems at he moment, the reason for making a project there. When you define what is going on and what is the problem in the first place you would at least have a clue in which way you would go or search.

It may smell there, it may cause the gathering of mosquitos, and insects that is not good. That is the start I mean when you get to that you start looking atwhat could be applied is there tht you should hve a specific bacteria ton live there, that is not biomimicry but for sure it's a biological solution – that's why I told you at the beginning I don't mind if at the end it's called something else. But you just need to understand that biomimetics has those things and those are the ways I personally worked with and I know that they are right because there are so many people working on that in so many ways and many claimed that this Is biomimetics which is not the case.

Feedback

The format was very nice it's only because I didn't know about the way you wanted to perform it so I thought it would be completely from my side and it was more difficult. Yes if I knew this earlier it would've been better. It would be important to send it to in advance but I believe the format was very very good. Informative and not time consuming.

08 | Biomimicry as a Design Practice

Team IILLAA
Author Lamiita Traista
Theme Research
Date 28.05.21
Appendix 08
Page 1 of 3

Here we present an overview on biomimicry as a design practice. Based on the literature, there are different levels and approaches to applying biomimicry as a methodology. Since we are looking into biomimicry in the context of design for sustainability, this worksheet builds upon the research done by Ceschin & Gaziulusoy (2019).

Levels of mimicking nature

When employing bimimicry as a design methodology, the level of mimicking nature is often something to consider. There are three levels being distinguished: form, process and system (or ecosystem). These can be interpreted based on their degree of sophistication, ranging from shallow, which is the most reductionist form of biomimetics, to deep which is the most complex [1]. (see illustration on the right side)

Biological models

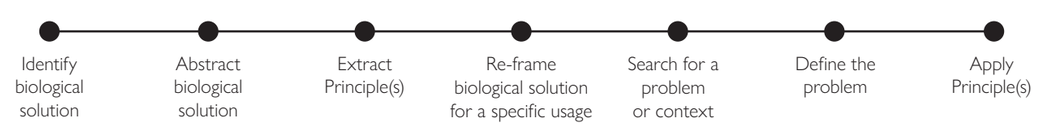
Upon exploring solutions from nature, there could be different types of natural phenomena, on various scales, that could potentially support the biomimetic design. These are referred to as biological role models or biological systems that can range from a part of an organism, to an organism or any other living system. For the purpose of organising biological role models in databases to support biomimetic approaches, these have been divided in categories such as: parts, physical phenomenon, organ, state etc. [2] For applying the biological system in design, this then has to be abstracted at the level found appropriate to match the context (e.g. "structural abstraction is done when talking about a specific structural system" - Hanaa, WS_12)

Design practice

When employing biomimicry as a design practice, there are two directions that can be adopted, based on whether the design team chooses to first look for an inspiring biological system in nature and then emulate it in different designs or the design team chooses to define a particular problem first and then look in nature for possible solutions. Here we choose to refer to the two biomimetic design directions as olution driven and problem driven introduced by Helms et al. [9].
The main, highly simplified steps for each can be seen below. Even though the process may appear strictly linear, in real-world applications, the process is more iterative as steps require evaluation and reflection [1].

Problem driven

Solution driven



Shallow

Form

Shinkansen bullet train [4][1]

Innovator: JR-West
Biological Model: The beak of a Kingfisher bird
Mimicking level: Form + implicit function
Design process: Problem driven
Strategy: The front end of the train was redesigned to mimic the shape of the kingfisher's beak that is able to move through air and water fast and with minimum impact / noise.

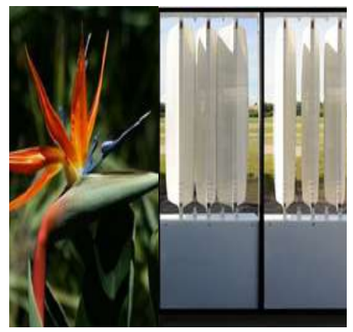
Velcro® [5][6]

Innovator: George de Mestral
Biological Model: Seed of the burdock plant
Mimicking level: Form + implicit function
Design process: Solution driven
Strategy: Inspired from the way a seed from Burdock plant attaches to an animal's fur to travel long distances before germinating, the innovation has been used in a applied in a wide variety of products such as shoe straps, jackets or laptop bags.

Process

Flectofin® [7]

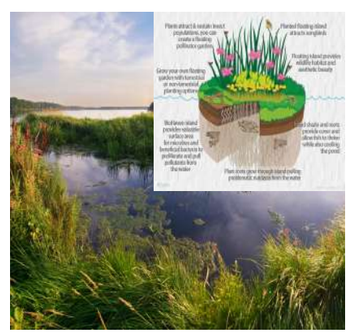
Innovator: University of Stuttgart's Institute of Building Structures and Structural Design
Biological Model: valvular pollination mechanism in the Strelitzia reginae flower (Bird of Paradise)
Mimicking level: Process
Design process: Problem driven
Strategy: Moving façades inspired by the mechanics of a very light thing that can open with very little energy, just like the flower that opens after a bird sits on it. The biomimetic process involved a deep understanding of the plant's mechanical performance.



System

BioHaven® Floating Island [8]

Innovator: Floating Island International
Biological Model: Wetland ecosystems
Mimicking level: Ecosystem
Design process: Problem driven
Strategy: By emulating wetland ecosystems, the invention improves water quality (by capturing, absorbing or filtering organisms, chemical entities, etc.), cycles nutrients as well as increases biodiversity. These biological and physical processes interact with many other factors, such as temperature and land structure, to affect a wetland's overall function.



Deep

08 | Biomimicry as a design practice

Team IILLAA
Author Lamiita Traista
Theme Research
Date 28.05.21
Appendix 08
Page 2 of 3

The following pages aim to offer some insights / considerations from literature to be taken into account when willing to apply biomimicry as a problem driven approach.

Problem driven approach to biomimicry - considerations

In order to get a better understanding of the underlying processes of biomimicry as a problem driven approach, Helms et al. [9] contributes with a valuable descriptive account of how multidisciplinary teams employed biomimicry in practice. Although biomimicry involves multidisciplinary, this type of approach is "[..] effectively led by designers identifying initial goals and parameters for the design" [13, p. 24]
Even though the generic steps of this process seem linear, in practice, it is very dynamic since understandings of the problem and the biological systems keep influencing and reshaping each other along the way [9]. This is because the output from later stages often influence previous stages, so the process becomes iterative, consisting of many feedback and refinement loops [9].

Defining and re-framing the problem

Upon deciding on a specific problem, this has to be re-framed so that it can lead to biological systems that can help solve the problem. Since this is not an easy step and most probably the problem needs to be revisited upon searching for biological systems, there are different suggestions on how to approach this.
The Biomimicry Institute suggested to 'biologize' the problem by redefining problems with biological terms, while Helms et al. [9] suggests the following two techniques as first step in defining the problem:
- functional decomposition: taking a complex function and decomposing it into sub-functions, since biological systems are complex, inter-connected and multi-functional, it is difficult to extract as single concept to use;
- functional optimization: defining a function or a set of functions in terms of optimization problem or equation (e.g. the analysis of moss into functional goals of the structure and placement: (a) reduce water loss, (b) increase surface area for photosynthesis, (c) position relative to the sun and (d) protect reproductive structures from environmental stress.)
After this, the problem defined should be re-framed in biological terms, often in the form of a question such as 'How do biological solutions accomplish xyz function?" (e.g. stopping a bullet --> what characteristics do organisms have that enable them to prevent, withstand and heal damage?) [9]

As these suggestions are quite general and open to personal interpretation, Cohen & Reich [12] propose tools, templates and guidelines to 'biologize' the problem, such as analysing the design space and identifying possible design paths by using the Function-Means tree method (see example of Function-Means tree for a screen protector design challenge in figure 1). This is to help re-frame the design challenge by generic functions and identify related structures (e.g. protect the screen against mechanical damage, change the position of the protector from full cover to full exposure)

Finding and abstracting biological solution

There have been many attempts to facilitate or even automatize the process of transferring knowledge from biological systems to design [9].

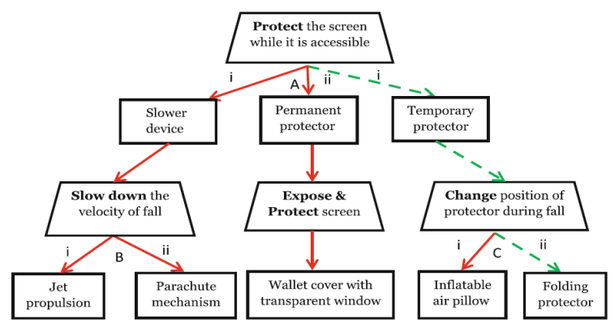


Figure 1: Functions-Means Tree[12]

This tool aims to analyze the design space by interpreting the design challenge into possible functions and means. Each branch is a possible design path that directs the search for a biological role model, according to the functions in this path.
Building up on the tree involves thinking of means to realize a function and then functions that each mean further requires. Function is signed with wide edge boxes, while mean with straight edge boxes. Example in the figure is for a screen protector design challenge.

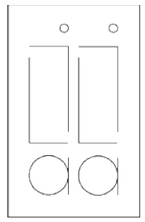
Popular solutions are databases that structure biological knowledge to support design teams. For instance, the Biomimicry Institute has developed an online library, AskNature, which indexes biological strategies by function [10].

Similarly, the SAPPHIRE tool [11][2] provides descriptions of the structures, behaviours and functions of biological systems and engineering designs based on various constructs:
- parts: a set of physical components and interfaces that constitute the system of interest and its environment,
- physical phenomenon: an interaction between the system and its environment,
- state: a property of the system - or its environment - that is involved in an interaction,
- physical effect: a principle of nature that underlies and governs an interaction,
- organ: a set of properties and conditions of the system and its environment required for an interaction between them,
- input: a physical variable that crosses the system boundary, and is essential for an interaction between the system and its environment
- action: an abstract description or high-level interpretation of an interaction between the system and its environment

Having biological systems detailed in these constructs is meant to serve as a methodology for supporting the "transfer" in biomimetic design from biology, especially with facilitating the level of abstraction needed for the biological solution to be employed in design [2]. This is to emphasize that (1) biological systems are more than form and function and that they depend on their environment to behave the way they do and (2) the more design teams are able to understand the biological system, the more its features can be successfully transferred to design.
After analysing the biological model based on its composing constructs, the level of abstraction of its environment depends then on the type of the design problem and the desired functions that need to be performed.

In the case of ecosystem biomimicry however, the more functions and related constructs are being explored and abstracted within the biomimetic process, the more efficient the overall performance of the biomimetic design. As Dama-Fakir et al. [14] argues, the overall design and performance of the biomimetic design with ecosystem as mimicking level depends on a deep analysis process where the biological system and its functions, critical components and interdependence of the various components should be explored by interdisciplinary experienced teams.

08 | Biomimicry as a design practice



Team IILLAA
Author Lamiita Traista
Theme Research
Date 28.05.21
Appendix 08
Page 3 of 3

Extracting and applying design principles

After having a deep understanding of the biological system to be used as role model, main principles should to be extracted in a solution-neutral form, so that constraints such as specific material or structure are left up for interpretation
For instance, instead of describing the principles of the abalone shell like 'interactions between flexible proteins and hexagonal calcium carbonate deposits', these can be phrase like 'tightly coupled composite material formation from alternating flexible and rigid structures for resisting impact' [9].

Upon extracting principles from the biological system, the design team made a translation from one domain into another (e.g. biology to engineering), while introducing new constraints to the biological problem.
For example, In the case of a bullet-proof vest, new weight, flexibility, impact resistance and manufacturing process criteria were added, along with new affordances, for example in materials. [9]

Common errors [9]

There are different mistakes that could be made when trying to follow a biomimetic process - Helms et al. [9] synthesized some of these error based on analysed case studies of multidisciplinary teams employing biomimicry. The most relevant ones are mentioned below:

1. Vaguely defined problems

Problems could be too vague to yield to functional description or result in too large search space. For instance, instead of definitions like 'lowering our dependence on oil', this should be stated like 'more efficient allocation of resources to reduce energy consumed in transportation'.

2. Oversimplification of complex functions

"Designers often miss the significance of an underlying principle because of simplifying assumptions, such as when using the term 'simply writhing', when in fact writhing is a very deliberate, complex motion." [9, p. 617]

3. Using 'off-the-shelf' biological solutions

"Commonly, designers seek to use an organism to 'do what it does' instead of leveraging the principles of the organism. This is the equivalent of using fireflies themselves to produce light, rather than understanding and applying the complex chemistry involved in bioluminescence." [9, p. 617]

4. Solution fixation

"Designers commonly fixated on the first inspiration source offered, initially focusing on it to the exclusions of investigating others, and then preferring it over all subsequent sources when instructors mandated comparative evaluations. Only one out of nine teams rejected their initial source in favor of an alternative." [9, p. 617]

5. Misapplied analogy

"When making an analogy, superficial or high-level matches are often forced into an incongruent solution space, yielding flawed solutions. For instance, a two-way traffic optimization algorithm derived from ant foraging behavior, applied directly to a throughput traffic optimization problem yielded an erroneous model. Fixation on this erroneous model resulted in three design revision attempts prior to it being discarded." [9, p. 618]

6. Improper analogical transfer

"During the process of transferring mechanisms from the inspiration source to the problem, mechanisms that are important in the source domain, but not applicable to the problem, are also transferred. For instance, while a dog nose is great at sorting through and identifying a multitude of different scents, if you're looking for just one scent in particular, there are filters in the dog nose that are unnecessary to the solution, but were nevertheless transferred to the design." [9, p. 618]

References
[1] Ceschin, F., & Gaziulusoy, İ. (2019). Design for Sustainability (Open Access): A Multi-level Framework from Products to Socio-technical Systems. Routledge.
[2] Sartori, J., Pal, U., & Chakrabarti, A. (2010). A methodology for supporting "transfer" in biomimetic design. Artificial Intelligence for Engineering Design, Analysis and Manufacturing, 24(4), 483– 506. doi:10.1017/S0890060410000351
[3] Pawlyn, M. (2019). Biomimicry in architecture. Routledge.
[4] Biomimicry Institute. (n.d.-a). AskNature — Innovation — High Speed Train Inspired by the Kingfisher. Retrieved from asknature.org website: https://asknature.org/innovation/high-speed-train-inspired-by-the-kingfisher/
[5] Alexandra Brumwell. (2020). Birds, bullet trains and biomimicry – theGIST. Retrieved from theGIST website: https://the-gist.org/2020/01/birds-bullet-trains-biomimicry/
[6] Biomimicry Institute. (n.d.). Versatile Fastener Inspired by Burrs — Innovation — AskNature. Retrieved May 28, 2021, from asknature.org website: https://asknature.org/innovation/versatile-fastener-inspired-by-burrs/
[7] López, M., Rubio, R., Martín, S. & Croxford, B. (2017) How plants inspire façades. From plants to architecture: Biomimetic principles for the development of adaptive architectural envelopes. Renew. Sustain. Energy Rev. 67, 692–703.
[8] Biomimicry Institute. (n.d.-b). Versatile Water Treatment Garden Inspired by Wetlands — Innovation — AskNature. Retrieved from asknature.org website: https://asknature.org/innovation/versatile-water-treatment-garden-inspired-by-wetlands/
[9] Helms, M., Vattam, S. S., & Goel, A. K. (2009). Biologically inspired design: process and products. Design studies, 30(5), 606-622.
[10] Biomimicry Institute. (2016). AskNature - Innovation Inspired by Nature. Retrieved from AskNature website: https://asknature.org/
[11] Chakrabarti, A, Sarkar, P, Leelavathamma, B and Nataraju, B (2005) A functional representation for aiding biomimetic and artificial inspiration of new ideas, Artificial Intelligence for Engineering Design, Analysis and Manufacturing Vol 19, pp 113e132
[12] Cohen, Y. H., & Reich, Y. (2016). Biomimetic design method for innovation and sustainability (pp. 1-253). Berlin, Germany:: Springer.
[13] Zari, M. P. (2018). Regenerative urban design and ecosystem biomimicry. Routledge.
[14] Dama-Fakir, P., Dower, A., Janisch, C., O'Connor, C., Otto, D., & Welz, P. (2018). Biomimicry and Wetlands.

09 | Application of Biomimicry within Urban Contexts

Team IILLAA
Author Lazaara Ilieva
Theme Research - Biomimicry
Date 04.02.21
Appendix 09

Within urban contexts, the field of biomimicry has been applied to architectural design, urban design and planning, and infrastructure design [1][2][3][4][5][6][7]. This worksheet reviews these applications with respect to sustainability and resilience. Different methods and case studies will be covered in order to exemplify current trends in urban biomimicry and the ways in which biomimicry can support and contribute to urban sustainability.

The literature frequently argues for the necessary focus of sustainability transformation efforts in cities due to their significant consumption of global energy and contribution to GHG emissions [1]. Given the naturally sustainable characteristics of living systems, biomimicry is seen as a promising methodology to apply in cities at multiple scales, from single mechanical units (materials) to buildings and even entire urban areas [2][3].

"Living organisms and the natural world are regarded as the key source of ideas for functional design of sustainable built environments." [2]

Architectural Design

Mimicking functional aspects of living systems - organisms or products of biological behaviour (e.g. nests).

Eastgate Centre in Harare, Zimbabwe by Mick Pearce.
Natural phenomenon: termite mounds' passive temperature-regulation systems.

Impact: Improving energy efficiency of building and reduction of GHG emissions.
Criticism: Not a full understanding of the science behind the climate regulation mechanism [4].

Flectofin® by University of Stuttgart's Institute of Building Structures and Structural Design.
Natural phenomenon: valvular pollination mechanism in the *Strelitzia reginae* flower.

Impact: Reduction of energy consumption in mechanical cooling systems via adaptive exterior shading systems in buildings [1].

Urban Design

Mimicking organisms, products of behaviours, behaviours as well as entire ecosystems, such that ecosystem services become guidelines for urban design and the built environment can contribute to the regeneration of natural ecosystems.

Boston Treepods by Influx Studio.
Natural phenomenon: morphology of Dragon Blood Tree and the ecosystem services of provisioning energy and air purification [5].

"Ecosystems are the best known examples of the effective organisation of life on Earth. Designing cities so that they emulate what ecosystems actually do, that is provide ecosystem services, enables design teams to know what the quantifiable site specific ecological goals should be for a development (either single building, neighbourhood, city section, or whole urban area) so it can potentially integrate with and contribute to existing ecosystems rather than deplete them" [6].

Ecosystem Services Analysis has been applied in cities to draw goals and actions for the redevelopment of urban spaces by undestanding local ecosystems and emulating it on the urban scale [2].

09 | Application of Biomimicry within Urban Contexts

Team IILLAA
Author Lazaara Ilieva
Theme Research - Biomicry
Date 04.02.21
Appendix 09

Mobius Project by Yaniv Peer for Exploration Architecture.
Natural phenomenon: Ecosystem recycling of resources.

Impact: Reduction of energy use, remote monocultured, agricultural land use, and resource use by using the various waste streams of the city as energy sources and to feed other processes; using biodegradable waste streams to provide food. Community building, education around nutrition.
Design strategies: Biomimicry (ecosystem-level), biophilia (human well-being), bio-assistance ('Living Machines' or 'Eco-Machines' use a complex ecosystem of specific bacteria, plants, zooplankton and fish to mimic wetlands). [7]

In the built environment, biomimetic innovations often remain within the incremental, addition-by-addition paradigm of gradual retrofitting. Ecosystem-level biomimicry, however, moves the conceptualisation of cities beyond that of a set of unrelated objects, toward a more systemic understanding, in which urban objects, like buildings, are understood as nodes within a highly interconnected system [4]. It is argued that the ecosystem approach has the potential to significantly contribute to the holistic sustainability as well as resilience of cities [2] [4] [5].
However, there are conflicting understandings of what true biomimicry is. "Copying something observed in nature is not sufficient to be claimed under the scope of biomimetics. If this were so, a painter could paint a house green and call it biomimetic because she was inspired by the colour of a forest canopy" [8]. Thus, it is important to consider to what extent and depth does ecosystem-level biomimicry study the processes and functions of ecosystems and to what extent tit mmics them.
In addition, it is also important to clarify the scope of biomimetic strategies, whether they encompass biophilia, bio-assistantce, bio-utilisation and bio-morphology, and how these strategies can be effectively combined.

Infrastructure Design

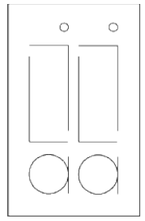
Recent trends in the application of biomimetic strategies to infrastrucutre design similarly focus on the mimicry of ecosystem processes and functions, with a particular focus on infrastructure resilience [3]. Ecological resilience principles are translated into tangible infrastructure design principles and strategies. The principles that are often used as guidelines in infrastrucutre design as well as in architectural and urban design are known as Life's Principles, which are design principles and patterns drawn from the field of biomimicry [3].

Life's Principles [3]

① Evolve to Survive	② Adapt to Changing Conditions	③ Locally Attuned and Responsive	④ Integrate Development with Growth	⑤ Resource Efficient	⑥ Life-Friendly Chemistry
Continuously incorporate and embody information to ensure enduring performance.	Respond to dynamic contexts.	Fit into and integrate with surrounding environment.	Invest in strategies that promost development and growth.	Skillfully and conservatively take advantage of resources and opportunities.	Use chemistry that supports life.
• Replicate strategies that work. • Integrate unexpected. • Reshuffle information.	• Diversity. • Self-renewal. • Resilience through variation, redundancy, and decentralisation.	• Cyclic processes, feedback loops. • Use readily available materials and energy. • Cooperative rltnships.	• Self-organise. • Build from bottom up. • Combine modular and nested components.	• Low energy processes. • Multi-function design. • Recycle all materials.	• Break down into benign constituents. • Build with small subset of elements. • Chemistry in water.

References
[1] López, M., Rubio, R., Martín, S. & Croxford, B. (2017) How plants inspire façades. From plants to architecture: Biomimetic principles for the development of adaptive architectural envelopes. *Renew. Sustain. Energy Rev. 67*, 692–703.
[2] Uchiyama, B. (2020). Application of Biomimetics to Architectural and Urban Design: A Review across Scales. *Sustainability (Basel, Switzerland), 12*(9813).
[3] Helmrich, C. et al. (2020). Using Biomimicry to Support Resilient Infrastructure Design. *Earth's Future, 8*(12).
[4] Pedersen Zari, M. (2014). Can Biomimicry Be a Useful Tool for Design for Climate Change Adaptation and Mitigation? In *Biotechnologies and Biomimetics for Civil Engineering* (pp. 81–113). Springer International Publishing.
[5] Aanuoluwapo, O. (2017). Biomimetic Strategies for Climate Change Mitigation in the Built Environment. *Energy Procedia, 105*, 3868–3875
[6] Pedersen Zari, M. (2017) Biomimetic Urban Design: Ecosystem Service Provision of Water and Energy. *Buildings, 7(*21), 1-13.
[7] Buck, N. T. (2017) The Art of Imitating Life: The Potential Contribution of Biomimicry in Shaping the Future of Our Cities. *Environment and Planning B: Urban Analytics and City Science Vol. 44*(1), 120–140.
[8] Jacobs, S. (2014). Biomimetics: A Simple Foundation Will Lead to New Insights about Process. *International Journal of Design & Nature and Ecodynamics, 9*(2), 83-94.

10 | Strong vs. Weak Biomimicry



Team	IILLAA
Author	Lazaara Ilieva
Theme	Research
Date	16.02.21
Appendix	10
Page	1 of 1

Here we present a reflection on the conceptualisation of biomimicry. Based on the literature, a distinction is made between a strong and a weak concept of biomimicry. The strong concept of biomimicry conceptualises nature as a measure by which to judge the ethical rightness of our technological innovations. The weakness of the strong concept is found in questionable presuppositions, which are addressed by the weaker concept of biomimicry, but at the price that it is no longer possible to distinguish between exploitative and ecological types of technological innovations [3]. Both concepts are compared in terms of four dimensions of biomimcry that are frequently discussed in the literature, nature, mimesis, technology and ethics [1][2][3].

Strong Biomimicry

NATURE

- Nature as a source of innovative solutions.
- Nature is perfect and perfectly knowable [1].
  - → humans have the ability to understand and 'know' the intricate functionings of nature's systems (i.e. human epistemic sufficiency to 'know' nature).
  - → requires detailed analyses at multiple levels.
  - → should be reproduced in biomimetic technologies.

MIMESIS

- Naturalistic mimicry.
- Biomimicry discovers natural processes and applies these processes in our technological design.
- Aim: identify, categorise, abstract, and deploy 'natural design' for the benefit of human civilisation and progress [2].
- Representational idiom of knowledge.

TECH.

- Separation between nature and technology.
- Janine Benyus: a science of nature [1].
  - → discovering and then emulating nature in technological aparatus.
  - → could give rise to a wholly artificial world, where pollination is outsourced to robotic bees and carbon is sequestered by artificial trees.

ETHICS

- Nature as a normative principle to gauge the appropriateness, ecological health and integrity of biomimetic designs [1].
- Bio-inclusive ethics.
- Risks naturalistic fallacy that assumes something is good because it is natural.

PROMISES

- Integration of human technology within natural ecosystems.
- Biomimicry can inspire new mind sets, values, and narratives con cerning the relationship between people and nature and alternative visions of development [1].
- Biomimicry offers an empathetic, interconnected understanding of how life works [1].
- Technological understanding of nature.
  - → productivity
  - → makeability
- Nature as intellectual property.

RISKS

- Risks compartmentalising nature for innovation.
- Supplementarity of technology: natural phemonon is taken out of its spatio-temporal context [3].
- Nature as an ontologically distinct domain divorced from society.

Weak Biomimicry

NATURE

- Nature is complex, temperamental and deficient in its conceptualistion.
- Nature is a deficient but improvable model
- Acknowledges desistance of nature.
  - → humanity has the imaginative capacity to make improvements on nature's constrained designs.
- Building upon natural inspiration with human analogical thinking [1].
  - → Neri Oxman: design-inspired nature over nature-inspired design.

MIMESIS

- Thinking analogously: grasping the schema of an object's emergence as a process with different limits and possibilities as a result of the specificity of the materials and organisation of the given milieu [2].
- Inspiration: encompasses a sense of co-becoming, coindividuation of form and matter.
- Technological representation needed to have nature appear for us.
  - → Mimicry is not only a representation of nature but also constitutive of the original [3].

TECH.

- Supplementing nature with technology.
- Neri Oxman: a technology of nature [1].
  - → from mimicking nature to editing and integrating it within design
  - → create a new context and history for a biomimetic technology.
  - → ensure it is well-integrated into its surroundings.

ETHICS

- Avoids naturalistic fallacy [1][3]
- Acknowledges that nature is not always sustainable in the sense of human-made visions.
- Risks the exploitation and destruction of nature.

References
[1] MacKinnon, R., Oomen, J., & Pedersen Zari, M. (2020). Promises and Presuppositions of Biomimicry. *Biomimetics (Basel, Switzerland), 5*(3), 33–47.
[2] Fisch, M. (2017). The Nature of Biomimicry: Toward a Novel Technological Culture. *Science, Technology, & Human Values, 42*(5), 795–821.
[3] Blok, V., & Gremmen, B. (2016). Ecological Innovation : Biomimicry as a New Way of Thinking and Acting Ecologically. *Journal of Agricultural & Environmental Ethics, 29*(2), 203–217.

11 | Biomimicry Framework

Team	IILLAA
Author	Lazaara Ilieva
Theme	Research
Date	05.05.21
Appendix	11
Page	1 of 2

This worksheet presents a detailed overview of our biomimicry framework that builds on the 'biomimicry for X' classifications as well as the 'weak vs. strong' biomimicry discussions. In particular, we discuss here the examples of biomimetic innovations and their positioning within the framework. Our aim in creating this framework is to contribute to deeper reflections on biomimicry, in order to ensure that biomimetic innovation can lead to the cultivation of more sustainable human-nature relations and interactions.

'Biomimicry for X' Classification

In the literature, various classifications of biomimetic designs have been developed. The classification that will be discussed here is broadly based on motivations for applying biomimetic approaches to the design process, i.e., a classification of biomimicry's promises [1] [2] [3]. We have synthesised these considerations in the literature as a 'Bioimimicry for X' classification and have identified four categories, which we have illustrated below as a spectrum. Within this range, we have placed different examples of biomimetic innovations to illustrate a tangible application of the classification. The reasoning behind their respective positions along the spectrum is detailed on the right.

Note: The varying placement of the examples in the vertical direction is for visual purposes only.

Biomimicry for Innovation techno-centric aims, user-product interactions, commercial interests.
Biomimicry for Sustainability net-zero aims, performance outcomes (e.g. enery and material reduction).
Biomimicry for Societal Transformation new social order within planetary boundaries.
Biomimicry for Biosynergy designing from 'within nature's mindset'.

Velcro inspired from the way a seed from the Burdock plant attaches to an animal's fur to travel long distances before germinating. Clear techno-centric aim of innovation, characterised by a novel approach to technical challenges [4].

Bullet Train mimics the shape of the kingfisher's beak that is able to move through air and water fast and with minimum impact or noise. Novel approach to technical (transportation) problem, but further to the right than Velcro given the minimisation of air resistance (which translates to a more fuel-efficient design) [5].

Silk Pavilion inspired by silkworms. Novel approach to technical challenge, but with a potential for lightweight structures [6].

Flectofin mimics the mechanism behind the movement of the bird of paradise flower when a bird lands on it, for adaptive exterior shading systems in buildings. Intention behind the design was the reduction of energy consumption in mechanical cooling systems, hence its position within 'biomimicry for sustainability' category [7].

Mobius Project mimics ecosystem recycling of resources. Within transformational category since it transforms the role of urban spaces in terms of food production, waste management, community-building and education [8].

BioHaven's Floating Islands emulates wetland ecosystems, improving water quality (by capturing, absorbing or filtering organisms, chemical entities, etc.), cycles nutrients as well as increases biodiversity [9]. Clear example of a human innovation that has a positive generative impact on nature. Not fully within the biosynergy category because the design does not necessarily intend to challenge the current human-nature interactions that are causing the degradation of water systems.

11 | Biomimicry Framework

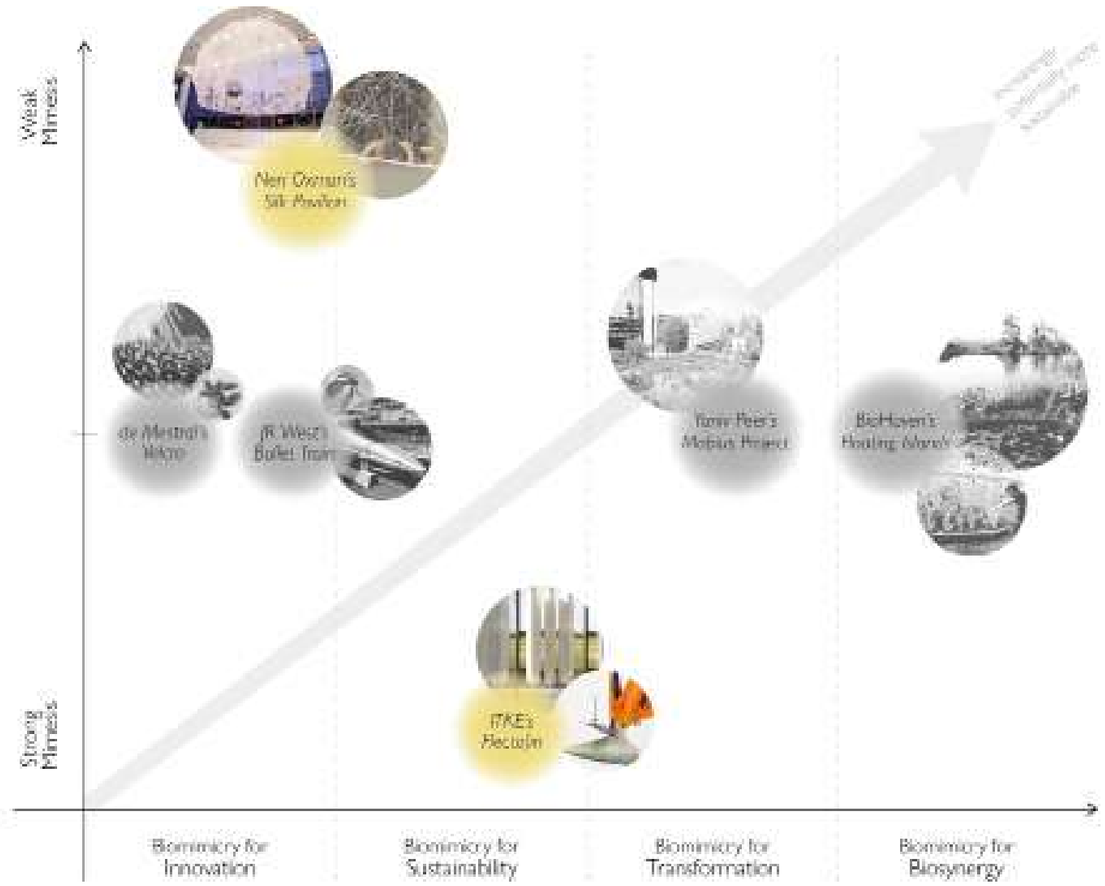
Team	IILLAA
Author	Lazaara Ilieva
Theme	Research
Date	05.05.21
Appendix	11
Page	2 of 2

Biomimicry for X * Weak vs. Strong

We argue that the conception of mimesis is an important element to consider for our framework as it is pivotal in framing the designer's relationship with nature. Thus, we introduce the second dimension (y-axis), that spans from the 'strong' conception of mimesis to 'weak' mimesis. By introducing this second dimension to our diagram, each mapped example is reassessed in terms of the conception of mimesis inherent to the particular design and is thus shifted vertically to be repositioned within the new range. This reassessment, however, requires an extensive review of the design process for each example that takes on a heightened analytical sensitivity towards this discussion of mimesis. In order to illustrate our framework, we present below an initial visualisation, in which we shift only a couple of examples, leaving the rest open for further debate.

Silk Pavilion moves up based on Fisch's discussion of her work as a neo-materialist approach to biomimicry by which design "emerges through inspirational technics of interaction with material nature" ([6], p. 806). Her work thus embodies a weaker conceptualisation of mimesis such that her designs become iterative processes between herself and nature, rather than following certain steps that aim for a specific biomimetic outcome as widely employed in biomimetic design practices.

Flectofin is moved down to represent the strong conception of mimicry inherent to the innovation. The design required a deep understanding of the plant's valvular pollination mechanism, which comprises a complex reversible deformation when an external mechanical force is applied [10].



Note: The placement of the black and white examples (Velcro, Bullet Train, Mobius Project, Floating Islands) is not related to the vertical range. They are left open for further debate regarding their conception of mimesis (and thus their vertical displacement), as indicated by the visual distinction.

References

[1] Pedersen Zari, M. (2018). *Regenerative Urban Design and Ecosystem Biomimicry*, 1st ed. Routledge: Abingdon-on-Thames, UK.
[2] Uchiyama, B. (2020). Application of Biomimetics to Architectural and Urban Design: A Review across Scales. *Sustainability (Basel, Switzerland), 12*(9813).
[3] MacKinnon, R., Oomen, J., & Pedersen Zari, M. (2020). Promises and Presuppositions of Biomimicry. *Biomimetics (Basel, Switzerland), 5*(3), 33–47.
[4] Biomimicry Institute. (n.d.). Versatile Fastener Inspired by Burrs — Innovation — AskNature. Retrieved May 28, 2021, from asknature.org website: https://asknature.org/innovation/versatile-fastener-inspired-by-burrs/
[5] Alexandra Brumwell. (2020). Birds, bullet trains and biomimicry – theGIST. Retrieved from theGIST website: https://the-gist.org/2020/01/birds-bullet-trains-biomimicry/
[6] Fisch, M. (2017). The Nature of Biomimicry: Toward a Novel Technological Culture. *Science, Technology, & Human Values, 42*(5), 795–821.
[7] López, M., Rubio, R., Martín, S. & Croxford, B. (2017). How plants inspire façades. From plants to architecture: Biomimetic principles for the development of adaptive architectural envelopes. *Renew. Sustain. Energy Rev. 67*, 692–703.
[8] Buck, N. T. (2017). The Art of Imitating Life: The Potential Contribution of Biomimicry in Shaping the Future of Our Cities. *Environment and Planning B: Urban Analytics and City Science, 44*(1), 120–140.
[9] Biomimicry Institute. (n.d.-b). Versatile Water Treatment Garden Inspired by Wetlands — Innovation — AskNature. Retrieved from asknature.org website: https://asknature.org/innovation/versatile-water-treatment-garden-inspired-by-wetlands/
[10] Lienhard, J. et al. (2011). Flectofin: A Hingeless Flapping Mechanism Inspired by Nature. *Bioinspir. Biomim. 6*, 1–7.

12 | CPH Strategies for sustainable development

Team IILLAA
Author Lamiita Traista
Theme Research
Date 14.02.21
Appendix 12
Page 1 of 3

The purpose of this WS is to give an overview of the strategies that are in CPH for sustainable urban development and where Miljøpunkt fits into these strategies.

Agenda 21 [1]

Agenda 21 is a plan of action towards sustainable development in the 21st century, adopted by the member countries of the United Nations in 1992. The Agenda 21 highlights the importance of implementing solutions locally, where citizens should play an essential role.

As Denmark adopted Agenda 21, it was decided that "[..] the municipal council must prepare an Agenda 21 strategy every four years, which describes how the municipality will contribute to sustainable development. The focus must be on how citizens, associations, organizations and companies are involved in the work." [2]

CPH Agenda 21 Strategies [3]

The Copenhagen municipality does not have a separate Agenda 21 strategy, but multiple strategies for different topics related to climate and the environment.

An overall vision for 2025 has been developed by the Copenhagen municipality [8] which aims to set an overall direction for how Copenhagen should develop "[..] holistically, interdisciplinary and long-term" [3]. Other relevant plans that contain goals related to urban nature in particular are described below.

CPH 2025 Climate Plan [4] & Roadmap 2021-2025 [5]

The Roadmap 2021-2025 supports Copenhagen's Climate Plan of becoming CO_2 neutral by 2025 and gives general directions of development for the city.

The main action points described in the roadmap are targeting the city's energy consumption and production, transportation and City Administration Initiatives of demonstrating green solutions for the city.

In regards to urban nature, it is only mentioned that in order to contribute to city's woodlands, which have the ability to absorb CO_2 and increase biodiversity, 100 000 trees will be planted in Copenhagen, while semi-urban tree planing will be carried out.

CPH Urban Nature Strategy 2015-2025 [6]

This strategy has been analysed in a previous project (SD2) and the main observations were the following:

- the strategy has two overall visions: 1. "creating more urban nature" and 2. "improving the quality of urban nature" [6, p.5]
- urban nature is emphasised as a means of "adapting the city to future climate conditions, enhancing biodiversity and creating optimal setting for an active urban life" [6, p.5]
- urban nature is defined as anything in the urban environment containing some kind of nature:
"[Urban nature] involves all the living beings and plants in the city [...] not just the overall green structure [...] but also a blackbird of a roof [...] dandelions pushing up among the cobblestones [...] at the same time, urban nature is urban, because it is the result of a planning, landscaping, architectural designs, planting, refinement and control, and because it is surrounded by the city and thus borders the urban space around it." [6, p.8]

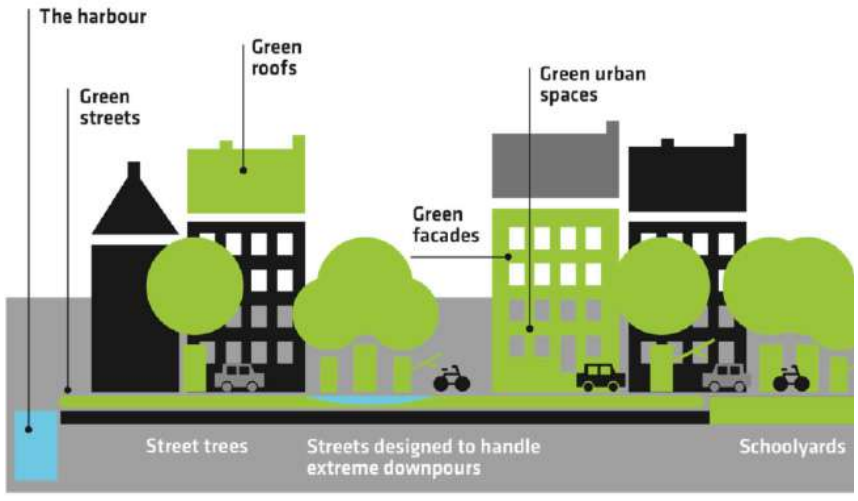
- Indicators have been described in the strategy in order to measure progress of meeting the visions. These include targets for proximity of citizens to an urban nature area, amount of citizens taking active part in urban nature developments and satisfaction levels.

CPH Trees policy [7]

Copenhagen has a tree policy with the aim of prioritizing "[..] the city's existing and new trees without hindering the development of the city" [7] (translation from Danish)
The policy supports the long-term CPH vision for 2025 [8] which has as goals that 75% of the citizens in CPH contribute to making the city greener, there is a variation in the tree species and 20% of the city's total area is covered with trees.
Citizens can contribute to securing more trees by entering a partnership with CPH municipality to plant and care trees delivered by the municipality or by reporting iconic trees that need to be preserved.

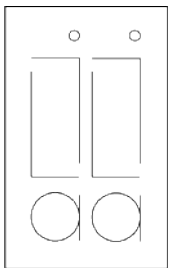
General principles for how to handle trees in CPH:

1. Existing trees in Copenhagen must, as a general rule, be preserved
2. Existing trees that have fallen must be replaced unless it is not physically possible
3. More trees will be planted in Copenhagen
4. Good growth conditions must be ensured for both new and existing trees in Copenhagen
5. A varied choice of tree species must be ensured in Copenhagen



Examples of urban nature presented in the Urban Nature Strategy [6]

12 | CPH Strategies for sustainable development



Team IILLAA
Author Lamiita
Theme Research
Date 14.02.21
Appendix 12
Page 2 of 3

CPH City Plan 2019 [5]

The City Plan is developed every 4 years and sets the frames for how Copenhagen should develop locally during the next 12 years, taking in consideration the overall strategies under Agenda 21, such as the Copenhagen Climate Plan 2025 and Urban Nature Strategy 2015-2025 mentioned above.

In the latest City Plan from 2019, six areas with green potential are identified. The municipality is working on a long-term area plan with suggestions on new and upgraded green areas, which are being identified on parameters such as proximity to housing.

For Østerbro in particular, the focus is mainly on developing Nordhavn, which has two areas with green potential, while in the old part of Østerbro planned developments are concerning new apartment and office buildings.

To make the city more attractive for pedestrians, the municipality will collaborate with landowners to establish green spaces and path systems.

Objectives:
- Recreational areas should accommodate the citizens' needs
- Green areas and open spaces should contribute to greening of the city, quality of life, biodiversity and climate adaptation
- The quality of green areas is to be improved
- The quality of wetlands should be increased
- The development of recreational facilities and green areas should develop in balance with population growth.
- Access to harbours, coasts and wetlands should be increased, mainly as a part of urbanisation

Where does Miljøpunkt fit in? [9]

Actors for meeting the Agenda 21 goals in Copenhagen have been setup in each district, that then developed strategies locally, thus referred to as Local Agenda 21 strategies.

Usually, the Local Committees of each district are the ones responsible for engaging citizens in working towards sustainable development.
In some districts, Miljøpunkt managed to take over the responsibilities concerning the environment and work on behalf of the Local Committee. This is also the case for the Østerbro neighbourhood, where Miljøpunkt Østerbro is developing one-year plans that support the CPH Agenda 21 Strategies.

Even though Miljøpunkt Østerbro has the environment as the main focus, the organization keeps a holistic view on all the related issues which have or may have an impact on the environment. Thus, their activities support also the overall goals of the CPH 2025 Climate Plan, such as reducing transportation and energy consumption, not only the Urban Nature Strategy in particular.

The Annual Plan

The annual plan deals with initiatives within the following focus areas:
/ Air pollution
/ Green areas and urban nature
/ Cloudburst protection and rainwater management
/ Waste and resource consumption

In addition, the environmental point will allocate resources for:
/ Communication
/ Networking activities
/ Visibility of environmental work.

Miljøpunkt Østerbro's mission is to raise awareness, engage and inspire citizens, companies and associations to change behavior towards a more sustainable lifestyle.

The Local Environmental Task

The environmental task involves the following efforts:

• **Support and develop local environmental work** by inspiring and engaging citizens, businesses and organizations in the district to actively participate.

• **Create local interest and dialogue on important environmental issues**.

• **Work for continuous improvements in the local environment**.

• **Launch activities** that make it easier for citizens, businesses and organizations in the district to act consciously in an environmental way

• **Contribute to selected environmental projects and campaigns** in the City of Copenhagen.

Miljøpunkt Østerbro's role

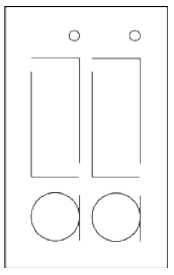
Miljøpunkt Østerbro will be working with local solutions related to global environmental challenges. It is central to bridge the everyday life of the individual with the global environmental challenges and focus on the local solutions.

The most important partners involved are:
/ Østerbro Local Committee
/ Citizens
/ Associations
/ Institutions
/ Businesses
/ City of Copenhagen.

The City of Copenhagen is committed to being CO2 neutral in 2025, and to work for the UN's world goals for a sustainable development.

Miljøpunkt Østerbro must fulfill a number of different roles in the district's environmental work, such as **mediator, inspirator, initiator, bridge builder, network creator, coordinator and front runner.** The goal is also to get a deeper understanding by offering a guided tour of workshops for those who are particularly interested in biodiversity or waste sorting.

12 | CPH Strategies for sustainable development



Team IILLAA
Author Lamiita
Theme Research
Date 14.02.21
Appendix 12
Page 3 of 3

Vision and Method

The vision is to be a **pioneer district** for sustainable metropolitan areas in Europe. Miljøpunkt Østerbro will promote sustainable development in the neighborhood with less pollution, more green surroundings and less resource consumption.

Their work wants to help reduce CO2 emissions and inspire towards a more sustainable living. The efforts must support the City of Copenhagen's environmental policy, action plan for the UN17 world goals and plan for a CO2 -neutral Copenhagen in 2025.

The overall working methods are divided into three main objectives:

1. Develop, support and maintain environmental projects.

2. Create local dialogue and raise significant environmental issues.

3. Document, visualize and communicate results.

Area of focus

The plan for the environmental work aims to find a synergy for the different areas, pointing towards a holistic vision for the city and district. Projects focusing on more green in the city are expected to make a positive impact on air pollution, and its sources can contribute to increased focus on green mobility, etc.

It is necessary for the environmental strategy to:
/ maintain **flexibility** to tasks that arise along the way
/ develop **long-term** projects
/ enter into **strategic** collaborations.

References
[1] United Nations. (2015a). Agenda 21. Retrieved February 14, 2021, from Un.org website: https://sustainabledevelopment.un.org/outcomedocuments/agenda21
[2] Københavns Kommune (2016). Bæredygtige Sammenhænge: Agenda 21-strategi for 2016-2019. Byens Udvikling, Teknik- og miljøforvaltningen, Københavns Kommune.
[3] Københavs Kommune. (n.d.). Københavns Kommunes Agenda 21-strategi. Retrieved February 16, 2021, from Københavns Kommune website: https://www.kk.dk/artikel/baeredygtige-sammenhaenge-koebenhavns-kommunes-agenda-21-strategi
[4] Københavns Kommune (2012). KBH 2025 Klimaplanen. Teknik- og miljøforvaltningen, Københavns Kommune.
[5] Københavns Kommune (2020). CPH 2025 Climate Plan: Roadmap 2021-2025. The Climate Secretariat, Technical and Environmental Administration, City of Copenhagen.
[6] Københavns Kommune (2015). Urban Nature in Copenhagen - strategy 2015-2025. Technical and Environmental Administration, City of Copenhagen.
[7] Københavns Kommune (2018). Københavns Kommunes Træpolitik 2018-2025. Retrieved February 16, 2021, from Københavns Kommune website: https://www.kk.dk/artikel/koebenhavns-kommunes-traepolitik-2018-2025
[8] Københavns Kommune (2015). Fællesskab København: Vision for 2025. Technical and Environmental Administration, City of Copenhagen.
[9] Miljøpunkt Østerbro. (2021). ÅRSPLAN FOR DET LOKALE MILJØARBEJDE. https://miljopunktosterbro.dk/wp-content/uploads/2021/02/Aarsplan-2021.pdf

13 | Sustainable Neighbourhood: Østerbro

Team	IILLAA
Author	Isabella Ursano
Theme	Research
Date	07.03.21
Appendix	13
Page	1 of 5

The Copenhagen neighborhood of Østerbro adapts the city to extreme weather using affordable green infrastructure that also improves quality of life for citizens. The Danish capital created the world's first climate-resilient district – Østerbro Climate Quarter – by implementing green infrastructure. This concept is cheaper to implement and maintain than expanding sewers, and it reduces the financial impact of extreme weather events. When completed, 30% of rainwater is expected to be managed this way, instead of ending up in the sewer system. In total, 50,000 square meters of cityscape will become climate-resilient, natural urban infrastructure.

The City

Copenhagen is the capital and most populous city of Denmark. The city has a population of 763,908 (as of December 2016), of whom 601,448 live in the Municipality of Copenhagen. Copenhagen is situated on the eastern coast of the island of Zealand; another small portion of the city is located on Amager, and is separated from Malmö, Sweden, by the strait of Øresund. Originally a Viking fishing village founded in the 10th century, Copenhagen became the capital of Denmark in the early 15th century. Since the turn of the 21st century, Copenhagen has seen strong urban and cultural development, facilitated by investment in its institutions and infrastructure.

The challenge

A single cloudburst in July 2011 caused over $1 billion in damage to Copenhagen, according to the city's Technical and Environmental Administration. Faced with the reality that these events will become more frequent in the coming years, the city is taking serious precautions to prepare itself. The Østerbro Climate Quarter's resilience demonstrates that adaptation measures not only protect citizens and infrastructure but also contribute to a more enjoyable and livable city.

Co-benefits

ECONOMIC

The green and surface-based climate adaptations of the Østerbro Climate Quarter will reduce the cost of damage from cloudbursts and are cheaper to implement than sewer expansions.

ENVIRONMENTAL

Creating greener infrastructure can improve air quality, sequester CO_2, and improve local biodiversity.

SOCIAL

More than 10,000 people have taken part in the project's 170 citizen-led initiatives to create green surfaces, usable urban spaces, and a climate-prepared neighborhood.

Combining city and nature

There are several urban activities, interesting residential areas, convenience stores, daycare centers, etc. On the other hand nature represents the opposite. We seek nature for peace, for contrast and nature's presence, along with the recreational aspect and the irregularity. The aim is to create a unique performative city-nature which increases the city's value and the recreational and extrasensory possibilities.

References
https://goexplorer.org/copenhagen-worlds-first-climate-resilient-neighborhood/
https://www.tredjenatur.dk/en/portfolio/the-first-climate-district/

13 | Sustainable Neighbourhood: Østerbro

Team IILLAA
Author Isabella Ursano
Theme Research
Date 07.03.21
Appendix 13
Page 2 of 5

The climate district in Østerbro shows the climate adaption of the future and the development of the existing city. In 2013 the project was selected by Sustainia100 as a visionary and innovative solution for the future climate friendly city. Tredje Natur wants to be a part of a developing bridge community which sets apart from the rest of the city. We believe that through cultivating the local resources we can create a strong coherent district, which in a few years can display the first climate- and urban space solutions as inspiration for the rest of the world.

BRYGGERVANGEN (The Green Spring)

Bryggervangen is a central street in the districts climate resilience. Tredje Natur calls the course The Green Spring, taking Kildervældsparken into consideration along with the water gushing into the street. By optimizing the parking lots placement and the width of the street, room is created for water drainage, nature and new bicycle paths.

In Denmark it rains 121 days a year. A typical drainage channel is conventionally dry 95% of the time. Therefore the channel has to be able to take advantage of the frequency of the downfall and increase the longevity of it in the positive urban space. The thought is to keep the water longer in urban spaces for recreational activities, along with other urban purposes for when the spring has dried out.

13 | Sustainable Neighbourhood: Østerbro

Team IILLAA
Author Isabella Ursano
Theme Research
Date 07.03.21
Appendix 13
Page 3 of 5

Sct. Kjelds square | Dead-ice

The square is the physical midpoint and should in the future pose as the natural meeting and gathering place of the district. Considering the central location and size, it has potential as a showcase and to display the climatic district, both nationally and internationally. The area is inspired by the dead-ice landscape, which occurs naturally several places around Denmark. During the ice age, the ice was withheld underground in pockets which slowly melted and left characteristic recess in the surface of the earth.

Today the circle is merely a roundabout, but will in the future be remolded to a collecting and spectacular element that has the characteristics of an artificial natural phenomenon. The circle will be lifted 5 meters above the terrain and have fog nozzles which will recycle the collected rainwater.

The essence is animating the surface of the square by creating nooks for sojourn, forming a wall against the vehicular traffic and establishing an inner area where city life can unfold on a small or larger scale. The bunds appeal to playing on and for exercising. This area is formed by a mixture of tiles, stairs that can be climbed on, as well as for sitting, and vegetation forming rooms.

The idea is to create an accessible vertical kitchen garden and a meeting place for the residents. This will also finish off the spacial area towards the Square. The ground where the residential gardens are placed, is highly polluted and therefore the area is risen to prevent damage. On the terrain the polluted area can be exploited as parking spaces which can free up other areas for recreative activities.

13 | Sustainable Neighbourhood: Østerbro

Team IILLAA
Author Isabella Ursano
Theme Research
Date 07.03.21
Appendix 13
Page 4 of 5

The Copenhagen neighborhood of Østerbro adapts the city to extreme weather using affordable green infrastructure that also improves quality of life for citizens. The Danish capital created the world's first climate-resilient district – Østerbro Climate Quarter – by implementing green infrastructure. This concept is cheaper to implement and maintain than expanding sewers, and it reduces the financial impact of extreme weather events. When completed, 30% of rainwater is expected to be managed this way, instead of ending up in the sewer system. In total, 50,000 square meters of cityscape will become climate-resilient, natural urban infrastructure

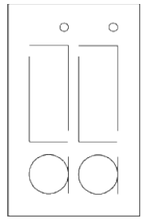
TÅSINGE SQUARE | The Brink

Tåsinge square is a 6.000 m^2 spacial delineated urban space. The centralised bunker is today covered by luxuriant oasis that appears as a wild growing hill. Surrounding the bunker is a large number of diagonally parked cars and wide roads.

Storing the rainwater is a part of Copenhagen's climate adaption strategy.The water falling from the sky is clear and does not contain calcium like our potable water. Today a large amount of the rainwater goes directly into the sewer. This does not only take up a lot of resources, but the sewer system also overloads due to the enormous amount of rainwater coursed by climate changes. The idea is to store the water using the clean downfall from the rooftops. The downspouts are connected to the gutter's which can, by use of gravity, be pumped up into silo's as tall as the buildings all around the district.

By optimizing the southern road- and parking area, an urban space is created which can conjoin with the judicious floor plan in Henning Hansen's apartment block, Solgården. This will be the base of the stores and sector. 80 % of the times we meet up with other people, it is in the outskirts of the city. The Brink is thought of as an urban edge between architecture and nature where our everyday lives interlace the two. The large trees and bushes will be kept, and form a green back wall for ballgames, play and meeting points. The edge of the bunkers green terrain will be optimized, prolonged and molded into an active zone focusing on motion, city sports and play. The Brink is south facing and being a bit away from the apartment block's roof profile, has good lighting throughout the day.

13 | Sustainable Neighbourhood: Østerbro



Team IILLAA
Author Isabella Ursano
Theme Research
Date 07.03.21
Appendix 13
Page 5 of 5

LANDSKRONA INTERSECTION

Today the area is mostly known for its thoroughly marked asphalt areas and there is great potential in thinking of this 4.300 m^2 urban delimited area as a conjoined surface for development. In the southeastern corner a café can be established and in the northwestern area there is sun throughout the most of the day. In the Northeastern corner the channel parts and provides

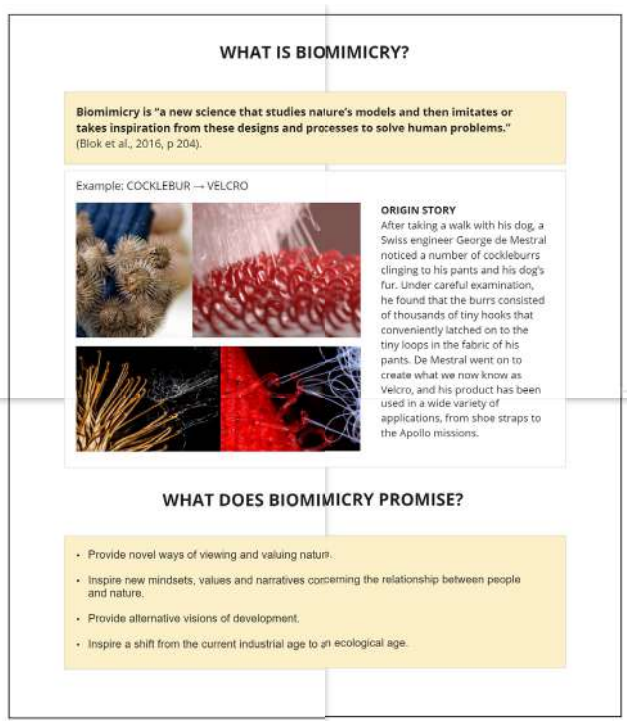
a good opportunity for water games as well as functioning as a green urban space. In the nook southeast of the potential café a water silo can be placed in front of the closed off facade. Along the southwestern edge there is shadow throughout most of the day and therefore this location will be most ideal for the necessary parking spots.

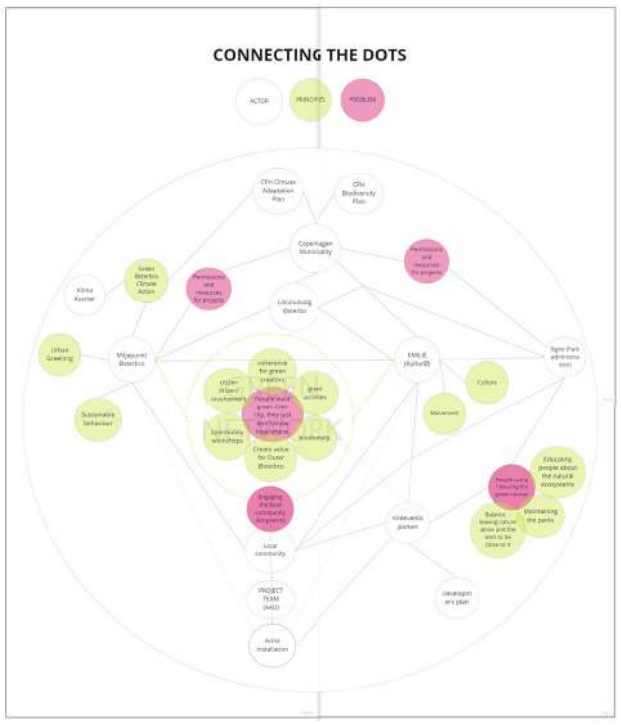
14 | Park manager at Københavns Kommune

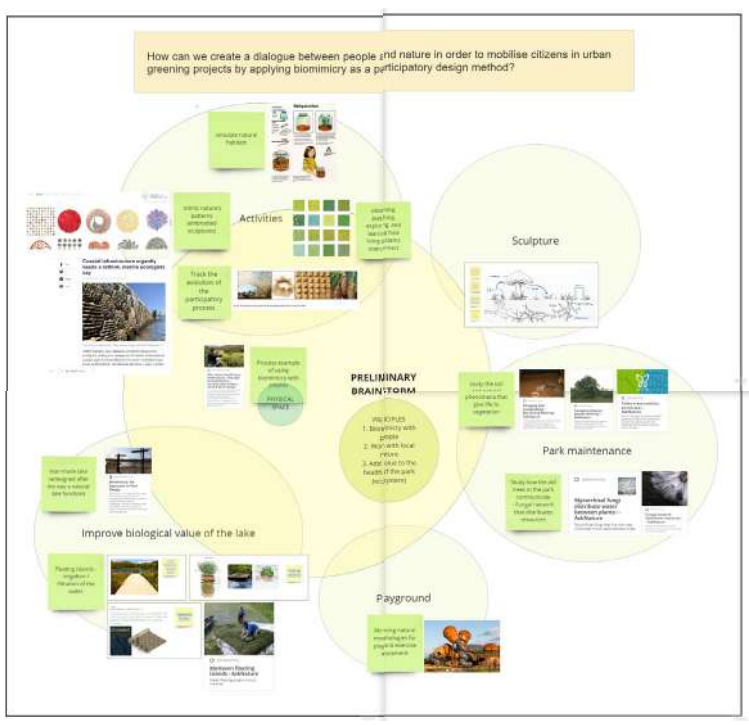
Team IILLAA
Author Isabella Ursano
Theme Semi-structured interview
Date 19.03.21
Appendix 14

KulturØ shared with us this contact, Signe Dragenberg, park manager at Københavns Kommune, in knowing more about Kildevældsparken, to better explore the local biodiversity and any problems that exist in terms of the park's biological value, and know more about the latest developments of the park and current challenges. Here below the transcribed interview we had online on Miro at the beginning of march (09.03.2021).

Presentation of the project on Miro Board







Signe: Very interesting and very inspiring and I think that I can see a lot of potential in all these suggestions but I think this part of working with the people and trying to educate them and teach them about natural systems is really really important. Because when I visit the park and I watch how people use or abuse, sometimes, the green spaces, then I always think about this: Why won't you take care of this stuff, why won't you please not tear the branches of the trees or pick all the flowers or .. you know. So this about making people understand what nature is and how we need to take care of it, I think it is very central in this [the presentation] and that's very very good.

Then I am unfortunately a bit marked about the fact that I have been sitting here for so long and what we often come to terms with is the big issue about money and lack of money to do different development projects.

But I think that this, of course it's so cute this playground stuff with the knots and all but it is totally out of reach unfortunately, but I think this part that is actually quite possible to do is the part about the floating islands.

And I helped over the past few years, there are people, citizens writing to me, asking me: what can we do about the birds in the park? Because I think that I've been maintaining this park for about 5 or 6 years, but prior to that, there used to be some kind of island for the swans in the lake and I think some remaining part of the chain is still there, but there was this island where they could be in peace and produce eggs and swans and all that. But the problem is that the kids or the young folks, they took the chain and tore it over the banks, so there was no peace left for the swans. And so, that part about respecting nature and carrying about it is very important to give it. But there are people wanting that floating islands back into the lake and I think that's a very great idea, and you know, not too big, not too complicated. Maybe good aspects in it also for working with people, so I think that is one of the things that would definitely be a great idea to work with.

And there is the stuff about the banks and about the planting or developing the biodiversity there and actually the winter of 2019 we did a new part of the wooden edge of the lake, you know what I mean, we renewed that and in that process the lawns on the banks were destroyed. And then this October-December 2020 we restored some of it by planting out soil and adding new soil and so on and putting grass mats that you can roll out. So we did that in some places and then we need to, this spring actually, to put out on some of the other banks, like flowering meadows to increase biodiversity. So that is the kind of the project that we are already working on. And depending on how busy you are and what the timeline is for your project, that could be something that we could involve citizens in doing.[..] Or we could do some extra sowing sometime. I think it's quite interesting you working with Kulturhuset Østerbro and Miljøpunkt. [..] I haven't been in contact with them so I haven't heard anything about the projects [..] but they also have perhaps some thoughts and some ideas as to what they would like to do. I have been working or talking a bit with .. it's not Emily but there was someone else before her, about .. I think he was Sweedish, a sweedish man.. And I've been talking to him about planting these edible bushes in the park and that could also be somehow connected to your project perhaps.

But as you know also the udviklingsplan (development plan) of the park and that is the mindset and the frame about what we can do and what we cannot do. So that's about quite a central planning tool of possibilities and restrictions, but the point is that there is no money attached to that plan. So we got the ideas, we got what we would like to do, but we cannot do it, we have to wait for some money to drop down from heaven. So that is kind of the challenge in some of this. And I still don't know how that works, whether Kulturhus Østerbro or Mljøpunkt has some money or a foundation to do anything?

Lazaara: Yes, they have the budget for creating the sculpture.

Lamiita: And Miljøpunkt also has some budget for creating and working with citizens for urban greening activities so they use the sculpture as an opportunity to do that around it.

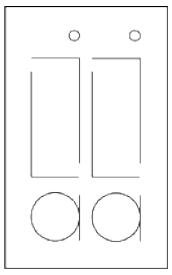
Signe: Ok, so they have some founding, but there was also an amount of money given to, they call it .. citizen driven ..

Lazaara: biodiversity strategy?

Signe: yes, that has some foundings in it and you can actually apply for it if you have a project that you would like to do, but I am not sure whether it has to be like regular citizens or you as a group could, but go ahead, you know. I can give you the contact, it's a new guy, a colleague of mine, that just started, Magnus, he's the guy on that project. And I think that actually in April that there is a timeline for this project. So that could be a way to create some financial support for any project. [..]

I think this stuff about the islands could be very interesting. Also because the challenge in these parks, because there are so many people going there everyday, so this stuff about leaving nature alone and that it actually needs time to regenerate, that's a big challenge in the city and about urban nature. And I think that this stuff about putting it out there and letting it peace, I think that would be a great think. And also to activate the water surface a bit, that would be great I think.

14 | Park manager at Københavns Kommune



Team IILLAA
Author Isabella Ursano
Theme Semi-structured interview
Date 19.03.21
Appendix 14
Page 2 of 4

Lazaara: And would that not - let's say the islands were created - would that not attract even more birds and that's kind of problematic for the lake, or has that been dealt with?

Signe: I have no idea, I have no clue about birds whatsoever, but I think in terms of making those development plans, we never really talked about problems about birds if they are too many or different kinds of birds. I mean that's not an issue that has been addressed in any way. So I'm not sure if anyone has actually thought about it.

Lazaara: No, I just got that from the 2013 development plan that in Kildevæld-sparken, in relation to the lake, that because people feed the birds there's an artificially maintained population of birds and the poop in the lake and that's not good because it adds even more nutrients in the water.

Signe: That's probably correct, because there is that problem of people being at the same place, same space .. yeah they think that its very purpose is feeding the birds but it is not, and that is another subject that you could perhaps address but I am not sure how you can put it into this mimicry - you can find a great solution, I'm sure... (laughs) but that is in general a big issue in the urban green spaces, this about feeding birds.

And it's actually funny, we can see that because of this the birds are overusing the park. We can see in the playground where all the birds get fed there is no grass. We got that also by Damhussøen - when you have a lot of birds, they actually destroy nature, because there are too many birds. So that's also when it really goes wrong - when nature starts destroying nature.

Lamiita: As a park manager, are you involved more in the strategies?

Signe: I'm kind of in between the daily maintenance and the strategies actually. Because [..] I am part of developing, not the strategies, but developing the udviklingsplan, which is attached to these strategies which are a bit higher up political strategies and strategies for maintaining trees and strategy for biodiversity. And then [..] my main working tool is the udviklingsplan and then I try to include them in the maintenance plan of the park. We have a maintenance plan for each park saying when to cut the laws, when to do something about the trees, when to water the plants and stuff. And then I try to work with implementing that into the daily maintenance of the park. But I am not, as such, responsible for the daily stuff. It is more like how can we do a small development stuff and I have a lot of colleagues sitting, having some money, and they got some money for trees and [..] some for biodiversity. [..] They got different issues that they work with and we try to put it out in the physical spots.
But unfortunately I don't have as much money as I used to do. So 10 years ago I could do something more out of my own, but now I am more dependent on these different kinds of founding. So that is a problem and that is also why there is not much development actually going on. It is more maintenance and repair when we get some money.

Lazaara: Citizen-driven maintenance – hard to work with volunteers.

Signe: I think that we have a few years back it was very political interesting to do this citizens involvement and being a part of maintaining different green areas and they were giving money to such projects. And our experience with it is that you got those people that are very interested at first and then it takes a lot of resources from us as managers, from the municipality in general to do these projects, and then there goes one two or three seasons and then people move away, or have kids, or get a dog or something else that...it's very vulnerable those kinds of projects and actually they were closed down.

In Nørrebroparken there was a garden, and prior to them coming it was just a lawn, and then they got this place and they put up different kind of places to grow stuff. And there were a lot of people there using it just to hang out, not people maintaining it, but using it as a garden. But those actually responsible, to water stuff, they kind of vanished. And then all of a sudden three years later, we got this place with a lot of people hanging around, drinking beer, abusing the place, and it took quite some time and a lot of money to clean it up. And those are the kind of experiences we've had that led us to say that we cannot use all those resources in the municipality to keep a few, a small group of citizens happy and let them feel that they are doing something for nature, because it's too expensive. And they might have a feeling that they are contributing to do something good btu its not saving us money as such. It's costing us time and not saving us money, and unfortunately that is two things that is running this business.

We got a few places where we still got something and that is very nature driven. In Utterslev Mose there is a bunch of older people maintaining a small place of nature. And that I'm not quite sure if it's still going on, but it went on for a couple of years. It was two times a year that they came out with sickles to cut the grass. Old-fashioned maintaining of nature. And some place on Amager and Utterslev Mose we have cattle walking around in the spring and summer, maintaining grass areas, but that is the kind of thing that actually works. It still takes resources to manage and to do it

And we also have somewhere in Utterslev Mose we got sheep. But we still as caretakers have to go in and cut the grass anyway, because there are weeds that we have to cut that and move it away because the sheep won't eat it. So even though we have the sheep and this kind of natural way of maintaining, we still have to interfere.

So in that way, a lot of those projects are… it's a benefit for the public, for those local people that participate, but it's not a win-win situation from our side, from our perspective. But that doesn't mean that you should not do it. But it's just that it's often used as an argument for doing this, that it's a win-win situation, but that is not the case.

But I think also that in Østerbro, and I am not sure if it's still going on, a lot of the trees in the streets and the soil underneath, I know that a few years back there was a group of citizens that started to plant flowers in it. And they had an agreement or a semi-agreement with the municipality, but that also kind of died out. There are few places left. But that's often the case, people wanting to do it and they like to do it the first time and putting the flowers in. And when they have to water it in the summer and they come down to take out the weeds and find that a dog has been shitting all over it – then it kind of dies.

It's not hard to start the projects, but it's hard to keep them going – that's the big challenge I think.

Lamiita: cattle – were experts involved?

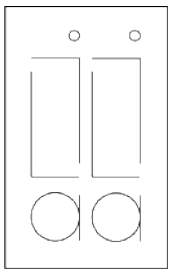
Signe: Yes, we got a colleague of mine, Paul Maslen, he's a biologist, he's working a lot with the cattle and with Amagerfaelled, and all that taking care of nature. So, he knows a lot about those processes, so he could be a man to talk to, the biological parts of this.

Especially in Østerbro, there are a lot of citizens that would like to participate in doing stuff for nature and about all this "save the world" kind of stuff. That is very modern in Østerbro – so I think that you chose a good location actually.

Lamiita: Railway tracks, wooden labyrinths_

Signe: Yes, that is actually a project that came I think about 8 years ago. I used to live by the park and that area was just a flat lawn beside the park. I was not involved in the process, but it is a project that should reflect the history of the area. And there used be this small railway on the place, when they dug out the lake, so that's the explanation about the railway tracks. And then it's about also working with nature and a nature-like park, compared to original Kildevarldspark which is

14 | Park manager at Københavns Kommune



Team IILLAA
Author Isabella Ursano
Theme Semi-structured interview
Date 19.03.21
Appendix 14
Page 3 of 4

very classical, so it's more about free nature and biodiversity.

And actually, just yesterday a citizen called me and asked whether she could get some of the branches that were taken down in the park and put them into the maze. And that's kind of the small stuff that we can perhaps do in terms of collaborating with the citizens. And the plan was also that the children from the playground and the institutions could use it to jump around on the stones.

Lamiita: So only made with branches and things from the park?

Signe: Yes, but as you can see in the end, down towards the school, we've got the problem of too many people at the same place, now that the school yard is being reconstructed. So, there we do not have grass anymore, just soil. And actually, down in that end of the park, towards the Kulturhuset and the school, there used be an iron fence on the entire way along the path. But that was taken down because the school and kulturhuset wanted a better connection to the park. And I can understand that, but at the same time I can see that it also resulted in the people walking across into the bushes. And you can do that if you are five people, but when you are 500 hundred walking there five times a day, then we cannot get the vegetation underneath the bushes to develop. So this about leaving nature alone and the wish to be close to it, is a problem.

Because it's so great that the school is there and they can use the park for education and for sports, running around on the tracks, but it is a problem when they start to go out into the bushes and that is what happened down there. And that is why we put cut-down trees along the path, but it doesn't really help. But also, we are talking about, in that area we would like to plant some bushes and some new trees, but in that case we would need to put up a fence, because otherwise it would not survive. So it's a fine line having people close to nature, but not too close.

Lazaara: citizen calls pattern

Lamiita: We went to the park last week and we saw these railway tracks and some labyrinth made of wood. Do you know how those came about?

Signe: Yes, that is a project that came about 8 years ago. I used to live by the park and it was a flat loan, that area beside the park. And then this project came and it was prior to being in the geographical spot and I was not involved in the process. But it is a project that should reflect kind of the history of the area. And they used to use this small railway on the place when they dug out the lake actually so that's the explanation about railway tracks. And then it was also about working with a higher degree of nature and nature parks compared to the original Kildersparken that is classical. It was more about free nature and about biodiversity and stuff. This is what it came. Actually just yesterday a citizen just called me as to whether she could get some branches that they could take down in the park, and whether she could use them into the mace. That's kind of the small stuff that we can do, cooperating with the citizens and the plan for also the children in the playground and institutions next door could use to jump around the stones.

Lamiita: So it's made from branches of the park?

Signe: But as you can see towards the school we got the problem of having people in the same place and that the school yard is being reconstructed and spaced. We do not have grass on the loans anymore and it's just soil. So these are some of the stuff. Actually down, at the end of the Kildersparken towards the Kulturhuset and the school, there used to be an iron fence on the entire way along the path. But that was actually taken down because the school and the Kulturhuset wanted to have a better connection to the park. I can understand that but at the same time I can see that it also resolve the people walking across into the bushes and that is again, you can do that if you are 5 five people but when you are 500 walking there five times a day we cannot protect the vegetation behind the bushes to develop, and this thing of leaving nature alone to be close to us. It is so great that the school is there and it can use the park for educations, and for sports, but it is a problem when they start to go out into the bushes and that is what happened down there that's why we put those cutted down trees along the path but it doesn't really help. But also we are talking about that when we are in that area we would like to plant in some bushes and some small new trees to renew the population of the trees. But then we have to put a fence because otherwise it won't be able to survive – it's a fine line in having people close to nature but not too close.

Lazaara: When you get calls from citizens, do you notice a kind of pattern or anything that they want or see that there is anything that has to be fixed?

Signe: I think that when people call is because they are angry about something. Unfortunately. That is often the functionalities, the benches, the garbage cans, the holes in the park or the mud. Stuff like that. And it's not that many people that call with ideas and wishes about development about the green because it's not necessarily in their mindset. But it has increased within the last 3 or 4 years this awareness about saving the planet, nature and biodiversity in that sense. But often they call or they write me why don't you put more flowers on the loans it's not that many that want to participate in maintaining the park. And it's quite a few calls actually. I perhaps have received five within five years concerning this park, that is not about garbage cans and benches. But I do know that there is a playground where there are people working there with the kids and they also have.. there is Anna that she is very interested in this environmental part. She also got a few parts that she maintains with the kids. So perhaps she would also be interested in participating.

Lamiita: Are you mostly responsible for Kilderversparken or other parks?

Signe: Yes, I got what they called it "ouderosterbro" from Jagtvej and then north. So I got Torsigneplads actually and then I got the Burgervagen, and "Sinemanstrad" and Burgevars Nature Park. And that is kind of more close to nature.
Lamiita: Did you hear by any chance any plans to connect these areas? Based on urban ecology they say that it would be best for wildlife to have some kind of stepping stones or have these habitats connected?

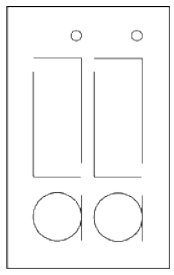
Signe: Oh like a green corridor - I don't think we have anything. Not to my knowledge. A lot of stuff in Osterbro is about getting the water away. There are a lot of projects about getting the water to the beach. And that is a lot of what is going on right now and we got this project on "Kanjilsenlee" just next to Osterbrogade where I think this year finally is a new project about leading the water away. It's a lot about the project and connecting these water projects and getting the water out of the city. So that's a lot about the political planning focus right now.

Lazaara: When you water the plants in the park where do you get the water from?

Signe: I think actually I'm not sure how it is now but last year we used drinking water to water all our plants and all our trees and then we started making actually places in the lakes where you could pop out the water and use that. And I think we got 5 or 7 or 10 spots around Copenhagen where you can get water. The plan was to be established in the park so that you can get the water from there to get the water for the plans and that is the general aim of the city to maintain the use of water. But there have been some technical issues when you take the water from Ouderselmoser there was a lot of stuff in the water that got into the wholes and we kind of couldn't get the water out. So low low practice issues and I think that we have overcome some of it. But also sometimes, like in Fillerparken, they used the water from the lake by mixing but then they had to stop because the water level was too low. But the general aim was not to use drinking water for the plants.

Isabella: For example if the water of the lake overflows where does it drain? Is

14 | Park manager at Københavns Kommune



there a problem about it first of all?

Signe: No, I don't think there is a problem. But actually the entire water system I think actually Kildervarsparken is one of the few that is not connected, because I think all the other lakes and water areas of the municipality are connected somehow and we got an entire department actually maintaining the water so I don't know too much about it. Actually, it is a natural spring of the lake. And I think that if there is too much water it just goes to the sewer. It is directly directed. But it is to my knowledge a close system and they were also, the department was screening the different lakes and how to use them as places to put water. And I remember it wasn't working with the Kildervarsparken lake because it was a close system so what do you get from it? So I think they went away from it again.

[logistic chat]

Lazaara: So thank you so much for taking the time to talk to us.

Signe: no, thank you. I find all this very interesting. My boss will probably say that I shouldn't use too much time on this but I thinks it's worth it to use time on. So I would like to participate in this and it would be great if we could do some small "one time thing" in the park because this involves people getting them regularly to do something about the work we could do. It's very complicated so I think you should keep it simple to make things work.

Lamiita: Just one thing – are on top of the regulation for example for parks? Do you have to explain to people what they have to do, what are the rules? For using the park, for doing something in the park. Do you have to explain to people what they have to do?

Signe: I have to or my boss, we have to kind of get a project and say what can be done and not be done I think especially when we have to do especially for the water, there are rules and regulations that have to be taken into account. Because there was also another project actually of cleaning the water in kildervarsparken that came the other day that was called "green care" – a company – a local citizen and they would like to do some bio-hotels with something about putting something down in the lake, and I first thought that was part of your project. So I was a bit confused (laughing). But yes it's two different projects about the same place. And actually they have contacted Lokaludvalg asking for money to do that project actually so I don't know whether you have contacted them? But perhaps they got some money. I can send you a contact info for you to talk to. But there are quite a few numbers of regulations to be approved in any projects.

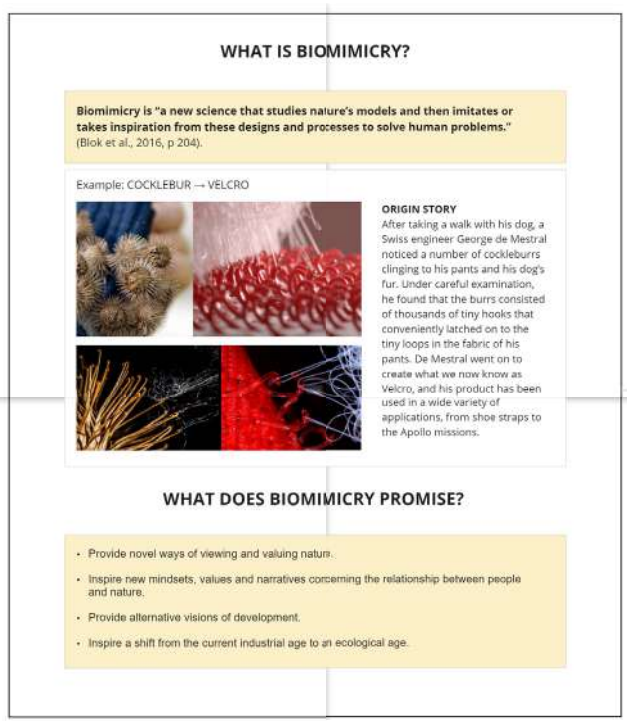
All: Thank you a lot Signe! It was a great pleasure. Talk to you soon.

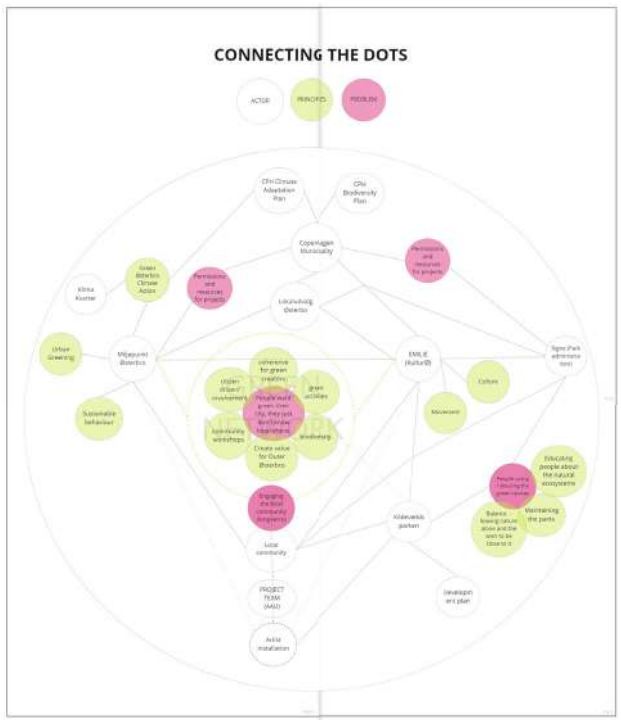
15 | Meeting with Sara, Louise and Emilie

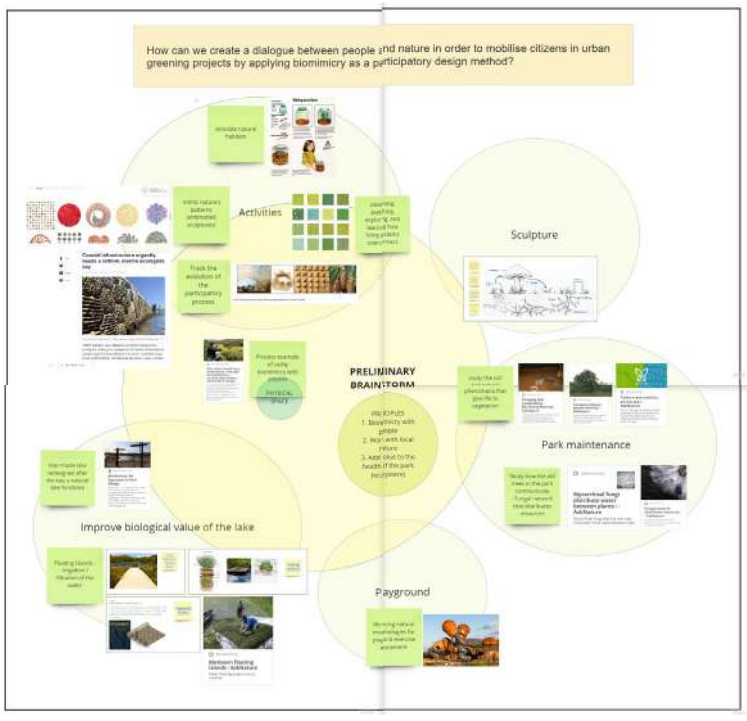
Team IILLAA
Author Lamiita Traista
Theme Empirical investigations
Date 08.03.21
Appendix 15
Page 1 of 3

The insights are from a meeting conducted on 08.03.21 with two representatives from Miljøpunkt Østerbro (Sara Jörn, the head of the organization, and Louise Purup Nøhr, project manager in the organization), as well as Emilie Bernt Haag, culture and project coordinator at Kultur Ø.

Presentation of the project on Miro Board







Emilie: Is it is this the same map you sent in the e-mail? OK, yes. Yes, I just want to find it because then. Yeah.

Louise: Yes. Yeah, I'm just looking for it as well, because it's hard to read on the screen again, so I'm just finding the picture on my own, my own laptop and. But I think I think it looks good. I took a look at it before the meeting, and I think it's I mean, it's principles and I think I'm a little bit curious about exactly how your project is going to like what kind of things that you want to do, like you're mentioning a community workshop and things like that. But I think the principles are looking quite good. And yeah,

Sara: I think so, too. It's a very sympathetic project as I see it. And also some of the the the principles. And the problem is very well named. I think maybe it's a challenge that should be mentioned is the collaboration with the municipality, because it's quite hard sometimes not that they are not willing to to cooperate. And it's just sometimes the it's a big challenge as to what are we allowed to do. And the the the maintainance is a very big issue whenever citizens have an issue to. The first challenge would be, of course, to to to get the permission, which depended on depending on the activity, could be more or less difficult. And the second is that even if you get the permission, you need to to sort out the question of the maintenance and logistics to as to where to put your spouse, Golo Hottentot, how to say that. Some tools to is to maintain width, where to keep it, how to get to it, how is it easily? How do you facilitate this in an easy way? And how do you manage it with your cooperation between the two? That's just to to to pinpoint. Not not a huge obstacle, but a challenge whenever you want to make a green community. How do you if you have the the citizens that really are really dedicated, how do we how do we know and how does the municipality know that they will keep maintaining something? And that's the one thing that I think maybe we could pinpoint a bit more or have to keep in consideration. And the second thing is, I'm a bit curious to know more about your thoughts of the art installation as to how that can be and how do you see maybe that's because I haven't been in the loop as Loise and Emilie enough. How do you see that as a source? Mm hmm. Yeah, I don't know exactly how to put it, but I think there is a and it's not completely clear in my head yet.

Emilie: And I don't know if you want to answer on that or if I should say something. Yes.

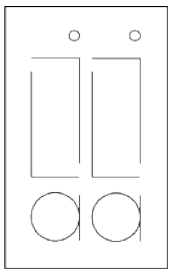
Isabella: Before you say anything. We were also wanted to know if there were some updates on the sculpture, because we remember that you had a meeting, I think, last week. And we also wanted to know what were the the what the outcome of it or. Yeah.

Emilie: Yeah, yeah, I can start to say that for me when I look at the map, I think it looks good to me where my name is that you could write Kultur Ø instead of Kulturhus because that would be more right. I think it's easier for you also to find in what is called empathy if you want to have something from the theory, from something like that. OK, but that's just a small thing. And then I think this map is also really interesting because, a, because we you put their support, which is also under the municipality, but they really work with the. Yeah, with me. And all the stuff is you you guys have more deep into it. And for me, it's just a it's just really interesting because I work with it with this because the politicians, the politicians and so on, say you you win enough that you need to. But if you're upset, I'm personally I'm really interested. So I think it's it's perfect. So I really want to go into it. But it's just interesting that I don't need the citizens to say I want to be more green. How can I do that? That's different. So that's why it's so good for me to to say, OK, how can I work with reapproved so we can make this great network? And so in that way it's yeah, it's working together because the information is coming because the politicians said we need to have this art installation to make a symbolic for the Green Network. But but. An art installation is just an art installation. We really need all the things around and that's the important job. And I had the meeting with Thomas Dambo and colleague or boss, I don't know what she is. And she will come back this week to tell us what, but how will it be the obvious solution?

Emilie: But how will the process be from now? And I talked about you guys and and I thought it would be so cool if your thoughts and maybe a workshop of what you could see could be a part of the process for the installation. And I hope she agrees with that. Otherwise, we can do it anyway, because the art installation, I think it will be in August, but we need to work like we talked in our meeting. We need to work with the citizens and how can we build this up? And I think your ideas about seeing on and on the nation, not only that they are the people, but they also the bees and the animals and stuff like that. And that's really interesting. I think that could be a really good way into it to create this green network. And then the art installation can be a product of that and can be they see how we can we talk about it because of grown up. Maybe we cannot gather up a lot of people, but maybe this art installation can be a project where like a meal where a lot of people come with different ingredients. So maybe all the schools are collaborating or something like that. They could produce and the of the installation and the companies around come in with all the stuff. And then we have a group of people who are building the distillation and and so on. So so that could be interesting to see. How can we how can we use this on installation to make that? And then hopefully this work and this process will be a really good ground foundation for the Green Network under the full name. But that's my point of view. And then you also need to know that I have something that I need to bring to the table and we'll have something else. And here there will be a lot of crossovers. But yeah, but but we have different interests. But the main thing is the same. OK, OK.

Sara: I think that's that's interesting. And it's about the project and about our corporation because we do have different goals as to what we need to to take off in our yearly plans and stuff. But the the and the synergy between a green transition and a cultural and artistic agenda is, I think, a necessity overall, because to make it and to make it a part of a cultural movement that is synthesis necessary to to accelerate and to to have the acceptance in a population that things are changing. And biodiversity is a very important issue in the green transition in general, but also in the aspect that the city is going to change. And some people need to want to be a part of that transition and change of their city, want to be hands on, get sold under the nails. Other people need to be convinced of the necessity to make space for different spaces, for instance. That means, for one thing, that the city might look less orderly in some some people's eyes. We need to have more

15 | Meeting with Sara, Louise and Emilie



Team IILLAA
Author Lamiita Traista
Theme Empirical investigations
Date 08.03.21
Appendix 15
Page 2 of 3

wilder in it. Look, we need to to have another aesthetic view on the city because we can't just have the perfect lawns or. Some places have to be dark or some. When you when you pull down a tree, it's a good idea to to let it stay in the park so that insects can move in, things like that. Is it? It needs a general acceptance in the population of the city and the collaboration or cooperation between. Organization like ours or a green organizations and cultural artistic, and you have organizations or people in general, we need to to make these different agendas and the synergies go together here. So that was my meta thought about it. But I think that's a red thread or whatever you call it in English that that has to be is the platform for collaborations like this. Something like that

Lazaara: And this this green network kin of is the. Could you say that's the representation of this Synergy? Or the kind of product of this, you know, wanted synergy of synergies, of agendas, a product perhaps, or not?

Sara: Well, that's again, that's a dialectic thing. It was just my adding on amylase point about bringing different things to the table, the necessity of bringing both things for the Green Network or any and the engagement of the citizens in in these agendas of cultural and green agendas and need to be broader now because the city is transforming. It should be transforming. We want to accelerate that process. Still, I think maybe I didn't get it. I wasn't sharp enough listening to Amelia's explanation or updating us on the art installation as to. How it can be a general, it's a are you saying that it might be a result of. And what we bring into the process now would. So and in the end, the results or instead is how perfect is it?

Emilie: And right now the everything is open and nothing is decided. And we know that the destination will be in Kilovolt Park and maybe around the what is called the position and recycle the same station. Yeah, yeah. And then at the meeting I had with the with the artists and it was really just about where we were talking about what we really want and how we wanted like we want. That is not an installation built. We need to make this a process and we know something. But really you know something and you guys, you students know other things and the citizens know. Yeah. So so for us, it's important that that that we can that we can bring your expertise into this process and that it could be a collaboration. And then it's not that the other situation is the result, because actually the distillation is the beginning of the Green Network and the Green Network, as I see it, will be the one thing that we that we need to collaborate in this in the beginning. And then hopefully in I think it will be in some years we can just move back and it could be only citizen driven. But what do I think? Yes. So nothing is decided, but we can try to to really form how this articulation should be, I hope, because Thomas Dambo, who is an artist and and he has, of course, ideas and thinks it should be in his way. But but this is really when we come with you guys, it's a it's a quality. So I really hope that that we can. Yeah. Have some influence. OK.

Lazaara: So the idea of the Green Network. It was just to get the chronological order of the development of these ideas, so the Green Network was kind of a first idea and then the municipality wait, sorry, maybe first start. Was it the municipaliy's kind of agenda to create this or to want to develop this green network?

Emilie: I think a thing you can leave it I think you always wanted to make this or working to make this put forward for. And we will continue to center the culture house that have three milestones, its nature and culture and. Yeah, and move movements. But the negative thing is really big thing for the for the country house and just the area around it is just have more focus on nature and sustainability and so on. And that's why the municipality the that the politicians decided to give some money for the sculpture and because the sculpture should be symbolic and a way to make these green networks. And that's what we got. And then I was like, OK, how, how, how can I do this? And then I contacted me and was OK. And I should make this. Will you be on board on this project? And then was. Yes. Let's let's see what we can do together. And yeah.

Sara: And then we are every year we do workshops with citizens, planting workshops or whatever. And there has been a couple of the initiatives from the from the local citizens that want to make is what's called a food garden.
Lazaara: Yeah. Of a farm urban farm.

Sara: And it's very, very difficult. And they have, I think, a more successful one in the head in Apple. We've had a one with which kept on going for a couple of years or three. And then it's sort of the wild that and we had another one a couple of years ago that was started by one citizen. And and I think you feel the same way when you work for he's sorry. Why don't you volunteer is is a. It's a hard thing to work with for an organization, because you have to take so many considerations to us to support and keep the spark and still facilitate. And people that are volunteers are very different, obviously. And some people want to decide everything and keep other people, and that keeps other people out. And how much do we go in and take decisions on behalf of the volunteers when we see that happening? For instance, what we do and have done is we go there with our Schaffel's, we communicate in our newsletters and social media and stuff so that we can make other people come. But if the chemistry within the group of volunteers isn't right or if they lose spark and then we go again with a maintainance and the municipality, what what what can be sustainable in the long run? How can we keep a good attitude without having to stand to to go there with our shovels every week ourselves? Because we don't have the resources for that. And there are many in. Many issues with green networks and networks in general that I'm sure that the media knows a lot about as well, because that's in that sense, it's not crucial whether it's green, a green network or any other volunteer work. So in this matter, we we have not only a wish for the municipality for for this special task that the media has received, but also for the whole municipality.

Sara: There is a wish for and devoting to involving the citizens in creating a strategy for a bio diverse biodiversity in Copenhagen that has to be finished in the next year. And in that task, they have hired the Danish Nature Preservation Organization, which is an organization, uh, to to and to be expertise. And we we have a good contact with them and have some loose ideas of how to to make people involved in guided tours and maybe a couple of workshops that we could bring into this this project, because it's, I think, very relevant to see all this engagement or possible engagement in the light of this biodiversity strategy. And the second thing is that we we've had a meeting with a pack of the. One person from the municipality that takes care of the other park filipacchi, and we try to get a meeting with the person you must know her, Emilie - Signe. Yes, we want to meet up with her and see how can we and how can we do some work. Jobs, where we decide together with the citizens what is going to happen, how can we make Kildevældsparken greener, how can we create a corporation societies for the first citizens to go somewhere and. Can something and stuff like that, and I think we need to hear of our options, but maybe you can set that meeting up. I mean, do you have a good connection with her?

Emilie: Yeah, it would have been perfect. I don't have a good connection, but I have a connection. And none of that is bad. But it's just that it's not that I know her personally. Yeah, we write together sometimes. So if you after words read to me,

Sara: we should because we've written one mail and maybe we should write another would say now we've been talking and so we're closer to what we really. We want to know about and let's meet up and talk about this project that you you guys, your project here,

Emilie: but you have a meeting with this Signe planned already, right?.

Lazaara : Yes we have one tomorrow. We're meeting with her tomorrow online.

Sara: Oh, yeah, you're lucky.

Lazaara: But we could. Yeah, I mean, it's tomorrow at nine, nine, nine to ten, yeah. I mean, we could all I mean, if you guys are free, we could also just have it all together, if that. helps

Sara: Thank you.

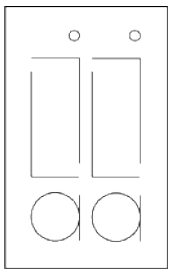
Lazaara: Yeah.

Isabella: I don't know if you don't have the time, we can update you for sure from the meeting, but

Sara: I'm just trying to think, what if that's the right approach?

Emilie: I think it could be good that you just you guys just have a meeting with her and just talk because you have a project and an assignment. And then that's one thing. And I think it could be really interesting that that you that she had heard from you guys first because you come with another. Yeah. And then later, it could be really interesting to have a meeting with all of us, all of us, because you guys can do something. But then maybe it's easier for me and for us because the culture house and everything. So so I think I could be a good way into it. And maybe it can be a start of finding out to make some workshops and yes. If you guys have some empathy or something like that. Yes.

15 | Meeting with Sara, Louise and Emilie



Team IILLAA
Author Lamiita Traista
Theme Empirical investigations
Date 08.03.21
Appendix 15
Page 3 of 3

Sara: Perfect. OK, but we also want to talk we want to talk about the whole of Østerbro in in this, that's why I am considering which approach that as best we want absolutely to do it is fine. But we also we want to involve the citizens in how to what do they want of their from their hood in general, how they want to see, first of all, being more biodiverse.

Emilie: But maybe Sarah. And then and then we just have that meeting with Signe, because it could be really interesting for you also to hear about that, because we also want to do that. So if we are more to support the project and then afterwards maybe have a meeting, all of us, because then it's easier to find out if we watch how to do it.

Sara: Yeah, I think I think we should have a meeting on. Yeah. Let's do it like that. Right. I think I'm going to leave you and is, as I said, the project leader from here and she will update me on what you in on the development and I'll be on and off. And sometimes we have resources to be too. Sometimes we don't. So I am very excited about the whole project. And I'll see you around.

Lazaara: Yes. Thank you, sir, for joining us.

Louise: I would just ask, did you want more information about the timeline or how? Because you asked with this idea come from this and the grea. Yeah. Did you get an answer to that question or did you want to know how we went with that?

Lazaara: We we would appreciate even more information just so we don't make any assumptions yet.

Louise: OK, we're going to say shortly and because as Sarah talked about, we always work with green networks in reporting this kind of part of our DNA. But in in the last year and maybe the last two years, we really tried to to him to be more of a platform for these green initiatives and green networks. And we started in our newsletter where we started having a calendar at the bottom where we try to collect all the like workshops or talks or all kind of events that that had something to do with sustainability. It is to try to like collect them in our newsletter. And then in the last year, we've made our new website. If and when we made that website, we also talked about how can we make this more of a platform for people who work with sustainability in Østerbro and nature. And so we talked a lot about that. And then we worked with the website and the newsletter and then immediately contacted us saying that we're doing this sculpture is the blue and green networks. And we were just like, I think that it's just just like really good timing. And so that's the next step was then that we worked with the media and to an and now we've made this. I don't know if you've talked about the Facebook group.

Lazaara: Yeah. Emilie briefly mentioned it to us. Yeah.

Louise: Yeah. So it's just to let you know. So it's always part of our our what we're doing and the reporting. Then we have the newsletter we had on your website and then email you contacted us sculpture plans and then we know we've made the Facebook page and there's all kind of part of the same. OK, yeah, great. Thank you, thank you for clarifying that we need to get as much information just so we avoid making any assumptions, OK, just because we the time is going and you guys still don't really have any idea of what what we want to somehow contribute in anyway.

Lazaara: So maybe I don't know. Isabella, let me tell you guys think it's OK if we move on to the next point, because we do have loads of questions, but we also want to kind of give you something as well. And so just to our kind of the way we started this project was with this concept of biomimicry just to Emilie. We told you this last time. But Louise, just to update you as well, just to kind of give you the background picture

[introduction of biomimicry and examples]

Emilie: Wow, it's so cool. It's really yeah, it's really nice. I think it's I think that's really important. And I think that's a big study. And and the big work for this project and we talked it or I talked a lot about this because, yeah, this is a you hear a lot of time projects were made and then the solutions are not adopted. So it's just like fading away. So I think that's it would be really important and would be really interesting to to actually use maybe I can take what I will call a just because I have another meeting in a few minutes. But is it possible to get these?

Lazaara: Yes, of course, the visualisations, yeah, of course,

Emilie: because I yeah, because I can also check with my boss about it and I think you would love it too. And and wouldn't we are further in the process. I also think you should have a meeting with him and because then we can figure it out. It it's something we can really see if we want to. We really want to focus on and then A, we have some kind of a budget. Can we use that? And so I think it looks so cool, but also a little bit green and this green thing. Yeah, but it could be so cool, especially with this sort of thing and the lake.

Lazaara: Yeah, yeah, yeah, yeah, yeah, yeah. That's kind of a priority in some way for us so that we make sure that because because biodiversity is kind of a on the agenda as well for, for it to kind of contribute in some way and for that to kind of the process is with people. But it's also in the end for as well as for the biological value. And it would be nice and more clear for people when it's in front of them. So we could look at just kill the market in particular, but then see how it could somehow expand our scale up.

Louise: I really like the metaphor with the mushroom. I think of the nice like with the how it spreads and how it grows. And and I think because I'm also I'm I'm not quite sure if I completely understand the biomimicry. Yeah. Because it's like there's also some of the things you talked about for like installations and like you create an island or something. And then there is a network which is not which is more like a floating thing. I mean, it's not a it's an object. Yeah. It's just like we used to the network, Pat, because I think it's more clear to me how it can be used to make like an installation or as a building or a playground or something. But how can it be used in creating the network? I think it would be really interesting.

Lazaara: Yeah, yeah, yeah, yeah, yeah, definitely. And we've been trying to figure out what biomimicry as well, because it is so broad and confusing. But I think we we have because it's our thesis, we can just kind of do anything with it, I think, and kind of define it in their own way. So I think that kind of gives us a nice flexibility and freedom to to see how it could be applied in different respects and kind of push the boundaries of the way it is usually applied, which is exactly for products and for technology and like this kind of really specific thing. But we could we could revolutionize biomimicry in some ways.

Emilie: Yeah, yeah. And and the to I think both of us are it is it is just a really big I mean not a problem, but I think always just loose. How can we we need to use the citizens. But how can we how can we make it work for for a long term. And it could be so interesting is this it could be a theory you can we can work with or could learn from. And that's that would be so interesting and great. We're happy.

Isabella: Yeah, OK. But we will send you the illustration on the email or for everyone. So yeah, you can read them again or take inspiration or whatever.

Emilie: Yeah. OK. And I'm going to say that Louise and Lama and I have a meeting tomorrow actually where we talk about where are we now in, in our work with the Green Project and what can we see the next step. And you have a meeting with seniors. So then maybe we should have a meeting. Yeah. Later this week or in the next week to see. Yeah, I am. Yeah.

Lazaara: Perfect. That will be perfect. Sounds good.

Louise: And do you have any more questions to us

Lamiita: about what we had was more like what what do you imagine this network, how how it could work? But I can see the challenges. So, like, yeah, I can see it's not so clear picture yet on on what how it should be maintained and all that kind of stuff. So that's what we wanted to see. You have already some something to find.

Emilie: Yeah, no. But I think tomorrow we will talk more about that and then we are really aware that it's not a project that would just say I would do it and then we're making it work. Is it going to take it a long time? And yeah, and I actually think it can take years, but I think it's a really important work. But but for now, we just read this Facebook group and we have to figure out how well, a good way to build the network up and and the network would not only be a group of people is like and we just said it would be some of the some people will make a planned workshop and some are really interesting in discussing thing. And, you know, it will be a floating network. So we just have to figure out how can we make and how can we make the best foundation for this network to grow? And that's our main A Yeah. And it's difficult, but it is really interesting. And this theory could be might be a way to look into it, to work with. Yeah. Yes.

16 | Kultur Ø

Team IILLAA
Author Lamiita Traista
Theme Research
Date 12.04.21
Appendix 16
Page 1 of 1

This WS describes Kultur Ø, one of the organizations that we collaborate with in our project. Our contact person in the organization is Emilie Bernt Haag, who is a culture and project coordinator.

Introduction to Kultur Ø

Kultur Ø is a network of institutions for motion, nature and culture in Østerbro, which is part of the City of Copenhagen's Culture and Leisure Administration (in Danish: Københavns Kommunes Kultur og Fritidsforvaltning) [1].
Kultur Ø's vision is to create a city that lives and grows together with Copenhageners, through literature, sports, music, and creativity [1].

Culture Centre Kildevæld

One of the institutions that is part of Kultur Ø is also the Culture Centre Kildevæld (in Danish: Kulturcenter Kildevæld), which has its physical location under construction currently.

Nature is being stated as a central element of the cultural centre which is meant to be integrated both in the architecture of the building and the cultural activities carried out, but also around the building. (for instance in the Kildevælsparken nearby). [2]

The construction project of the new centre is expected to be done in 2022, but meanwhile, cultural activities are still being organised around Kildevældsparken. [2]

"It is the vision that Kildevæld must be a versatile and flexible house that can create synergy between culture, movement, school and nature." [2]


Illustration 3: Kulturcenter Kildevæld, Atrium

Illustration 2: Kulturcenter Kildevæld, aktivitetsrum

Urban greening activities and collaborators

An example of urban greening activity organised by Kultur Ø in Kildevældsparken is a workshop for building insect hotells and bee nest boxes.

The event will take place on May 18, 2021. [3]

Kultur Ø organises and facilitates green activities and workshops regarding nature, food waste, biodiversity and urban greening. (Emilie, interview)

Some of the activities are done in partnership with other organizations who come up with project ideas - one of the organizations that Kultur Ø worked closely with so far is Miljøpunkt Østerbro.
"We reached out to them a lot. [..] The hope is that when Kulturcenter Kildevæld is finished, they will either have activities there or move their office there." (Emilie, interview)

Vision for greening Østerbro

According to Emilie, Kultur Ø would like to create "networks of greening", so that there is more coherence for the green creators in Østerbro.
Kultur Ø shares similar aspirations as Miljøpunkt in terms of focusing more on activties in outer Østerbro:
"Inner Østerbro - since about 5 years ago - has been differentiated from Outer Østerbro, as being more about moms that drink café latte, but Østerbro is much more than that." (Emilie, interview)

The wish is thus to build a frame of where more value can be added in terms of urban greening.

KulturØ's agency

Compared to Miljøpunkt Østerbro, which is run by only three people, Kultur Ø has a larger team, more resources and a closer relationship with the other Administrations in the City Council that have decisional power.
In addition to the culture in Østerbro, Kultur Ø has also a city-wide department called DIT: KBH (meaning "your Copenhagen") which functions as a unit to bring together the culture houses in Copenhagen.
The focus is on volunteering, co-creation and creative entrepreneurship at the city level. [1]

The art installation project

Kultur Ø has received money from the Copenhagen municipality to create a sculpture to inspire urban greening and become a symbol for the green activities and networks of Østerbro.
The sculpture is envisioned as "a coherent place where green activities can happen" and ultimately grow and proliferate throughout the neighbourhood (Emilie, interview).

In this sense, the sculpture represents a kind of material manifestation of Miljøpunkt's vision of the "green network".
Given this alignment of agendas, which was explicitly articulated by Sara from Miljøpunkt as "a synergy of agendas" and visualised below in figure 1, Kultur Ø reached out to Miljøpunkt Østerbro to help establish this green network as a (metaphorical) foundation for the installation of the sculpture.

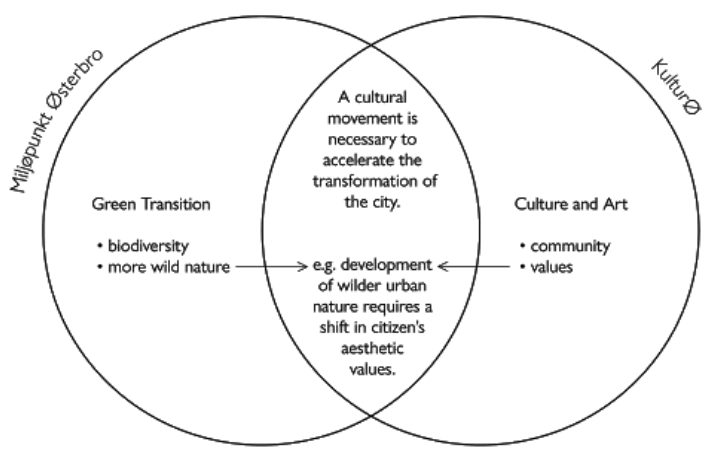
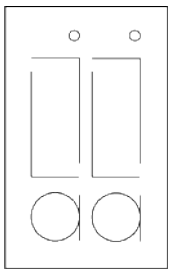


Figure 1: Synergy of agendas between Kultur Ø and Miljøpunkt Østerbro

References
[1] Københavns Kommune. (n.d.). Kultur Ø er... Retrieved April 12, 2021, from kulturoesterbro.kk.dk website: https://kulturoesterbro.kk.dk/vi-er
[2] Københavns Kommune. (n.d.-a). Et kulturelt mødested på Østerbro. Retrieved April 12, 2021, from kulturoesterbro.kk.dk website: https://kulturoesterbro.kk.dk/artikel/et-kulturelt-moedested-paa-oesterbro
[3] Københavns Kommune. (n.d.-b). Insekthotel workshop og suppekøkken. Retrieved April 12, 2021, from kulturoesterbro.kk.dk website: https://kulturoesterbro.kk.dk/node/4086

17 | Meeting with Louise and Emilie



Team IILLAA
Author Lamiita Traista
Theme Empirical investigations
Date 15.03.21
Appendix 17
Page 1 of 1

The insights are from a meeting conducted on 15.03.21 with Louise Purup Nøhr, project manager from Miljøpunkt Østerbro, as well as Emilie Bernt Haag, culture and project coordinator at Kultur Ø.

Updates regarding the art installation

• Alternative for the trolls - get citizens to make a greener area

• Thomas Dambo: They are talking about making the sculpture as a kolonihavehus. Small gardens and houses especially near the train tracks - it's a thing in cph for people living in Copenhagen so they can have some green spaces.

  • Kolonihavehus has become a cultural thing in Denmark --> communal shared thing --> it also has to be a social thing and open up to people.

• Thomas ideas - wants to make an open kolonihavehus - more fairy tail and spacy, the dimension should be special. WIth little tables and bushes, make it like an oasis

  • There are kolonihavehus also behind kildevældsparken along the train tracks.
  • Green network could include the people from existing kolonihaver.

• Good foundation for the network

• Good connection to the school --> talk about plants and recycling --> it's a good alternative to the troll, good foundation for the green network. So it's a place where we can meet to increase this green network.

• Will be around the recycling station - Thomas knows people from there and uses materials from there

  • It should be a place where people can say: "oh we can do the same in our yard"
  • Inspiration for people to go home and make it themselves
  • Place where people can come can learn about plants and recycling

• The sculpture will be the house - not a closed house, but open kolonihaven house

  • Should be a lot of activities around it
  • He uses a lot of material from the station creating a second recycling station. Inspiration place where to learn about recycling, green, biomimicry. (for the artist) It is important that it is beautiful and weird.

• Mimi - Thomas Dambo's colleague - Emilie introduced us to her in case Thomas will want to include some more people in his work

  • Emilie's idea is that maybe the school children are coming to collaborate with something for the sculpture, DUI with other things, Miljøpunkt etc.
  • Uses the: School, DUI (primarily for children - scouts - bicycle repair station replace spot instead of the containers), citizens
  • If everyone can come with small piece of things that would be nice

• Ilka - citizen that contacted Miljøpunkt - she wants to make an oasis around the area with the sculpture

• Maintenance of the sculpture

  • Beginning - KulturØ will be responsible
  • Emilie hopes that schools and other organization in long term
  • Emilie: experimental approach to its maintenance - hope to be more free where people can come and plant their plants and get inspired from it - hope to be a citizen-driven space.

• Sculpture size - depends on the recycling station and the use of the space currently as a parking lot

• Sculpture will be built around August - September

  • Emilie will send us the sketch of the sculpture (if she has sharing permission)
  • It would be nice to build up the network around Kildevæld meanwhile.

• There are some young folks gathering around in Kildæveldsparken and there are 2 pedagogs that made a group (youth club) for them in the park to meet - they could be involved in building the sculpture

  • Green and the environment aren't their priority in life --> they are people with less resources and they don't have a place where to stay. They don't feel to fit in in the youth group. They gather around grown ups that work with children.
  • The group of guys is not a big problem for the park, but it is a problem that they don't feel accepted.
  • It might be challenging to work with them, but hopefully it will help to include them in the sculpture building process
  • To make sure that they don't do stupid things, there are actually cameras at the recycling station in case something happens
  • Emilie talked with the boss of TD: build the sculpture as a recipe. So everyone is interested in the sculpture, if everyone can come with small pieces to contribute in building the sculpture.

• Street in front of recycling station - how will it work with children - need to figure out if there should be a fence around the sculpture

• It is ok to use the wall around the recycling station for a potential intervetion.

Tension between human and non-human use of parks

Louise:

• Kolonihaver - gardening, not wild nature, but maybe wild and gardening should not be separated

• Bridge the ideas of what nature is - wild vs controlled gardening

  • Gardening on one side --> biomimicry shows the beauty and the wildness.
  • Time is important: gardening is quicker. Help bridge these two ideas of greening and park

• Why do we have green spaces in the city?

  • Both biodiversity and for humans, but sometimes they become opposites
  • Better connection between human use and non-human use.
  • Access to these parks is needed - how to protect them but maintain public access?

Emilie:

• These projects could be seen as steps for citizens to educate themselves and see nature in the city in a different/new way.

• Biomimicry as a new way of thinking - a place where 'normal' people can understand

"I haven't looked at this ever before and for me it is wow, a new way of thinking. Make a place and a culture where normal people can understand it."

Louise:

• Squirrel trees in Fælleparken

  • Squirrel park in Faellerparken: is a good example where people made some little bridges and made an environment for the animals and they can go there and feed them.
  • They thought it was a good thing, but from the natural perspective it is very bad because they don't need to be fed by people and not as much. (insights from Henriette)
  • People destroy nature and habitat. What is best for nature?
  • Kommune took it down, but people got angry
  • Humans are users, but squirrels are also users - conflict on how to protect nature but open it up at the same time.

18 | Kildevældsparken

Team IILLAA
Author Lazaara Ilieva
Theme Research
Date 10.03.21
Appendix 18
Page 1 of 4

This worksheet presents a synthesis of the municipality's development plans for Kildevældsparken (2013 - 2018; 2019). The historical background of the park is covered, as well as the park's existing wildlife and characteristic landscape. Next, the various elements of the park are explored, followed by a review of the conservation conditions, the users of the park, and finally the visions and wishes for its future development.

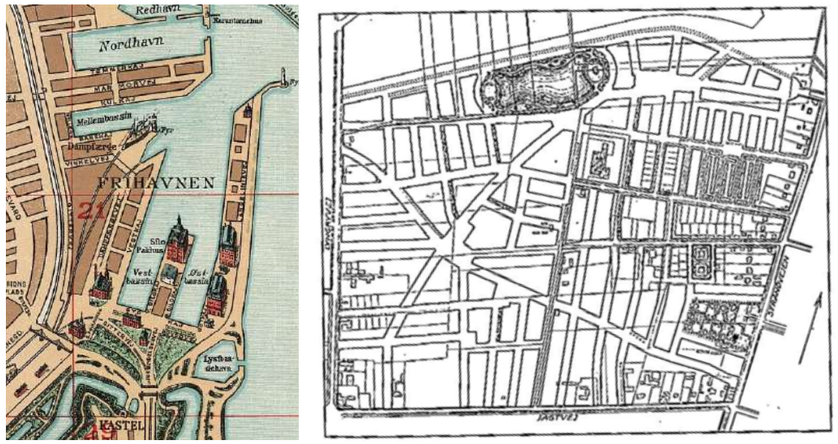


Figure 1. *(Left) The Free Port of Copenhagen, 1895 [1] (Right) Proposed street plan for the neighborhood from 1896 designed by Ambt and Plesner [2].*

Historical Background of Kildevældsparken [2]

Kildevældsparken is one of Copenhagen's smallest parks, located in Skt. Kjeld's neighborhood of Ydre Østerbro (Figure 1). It fills 7700 square meters, between Vognmandsmarken / Bellmansgade and Borgervænget. Despite the small size of the park, there are several trails that lead around the lake and around the park.

The park was laid out between 1926 and 1927 and is believed to be named after a spring that existed in the area and was visited by people who believed that the water was healing. Today, in the middle of the park is the lake, Kildevældssøen, which fills most of the area (Figure 2). It arose in the 1890s when large excavations took place to procure materials for the building of the Frihavnen (the Free Port of Copenhagen) and Langelinjekajen (Figure 1). During the excavation, large amounts of water suddenly flowed in from an underground aquifer in the area, creating the lake we see there today.

In 1896, a comprehensive town planning proposal was prepared for the neighborhood between Jagtvej, Strandvejen, Lyngbyvej and Borgervænget. The proposal was prepared by city engineer Charles Ambt and architect Ulrik Plesner, and the plan included a number of green areas that were to be character-creating for Skt. Kjelds Kvarter. The only green area that was established when the area was first developed was Kildevældsparken.

Figure 2. *Kildevældssøen in Kildevældsparken [4].*

The Landscape and Wildlife of Kildevældsparken [2][3]

The park was originally laid out with bushes, flowering shrubs and trees along the roads, a slightly winding main path with groups of willow trees around the lake, and individual groups of pine trees. Today, the park has a similar decor as when it was built and is considered an ornamental park. Some larger trees have been felled due to age, and new ones have been planted in the same places.

The species that make up the park's forest are hornbeam, maple, ash, beech, oak, bird cherry, pine, golden rain, hedgehog, dogwood, linden, navr, willow, robinia, yew, hawthorn and walnut. In total there are about 170 larger trees, of which hornbeam constitutes the largest group with 58 specimens. The largest trees are all the same age, and the trees are assumed to have been planted at the same time, which corresponds with the park's construction in the years 1926-27. The predominant species in the bushes are privet and snowberry, but there are also maple, ash, hornbeam, bonewood, barberry, boxwood, cotoneaster, elm, among others.

Despite the fact that Kildevældparken is a small park, the vegetation is nevertheless perceived as being diverse. There are thus opportunities for many experiences with the flora of the park as the different types create opportunities for experiences with native birds and insects.

According to studies conducted by the Fish Ecology Laboratory, there is virtually no vegetation in the lake. One of the reasons is that the brink is so steep that it quickly becomes too little light for plants to grow. Five fish species were found in Kildevældssøen, namely shells, perch, carp, tench and goldfish. The lake attracts ducks, gulls, swans, coots, moorhens, cormorants and herons - making the park a good place for birds. Though the lake has been observed to be a breeding site for coots and swans, nesting sites are not present due to the lack of vegetation along the lake shore. The trees and shrubs are habitat for other birds, such as sparrows, great tits, blue tits, pigeons, jackdaws, hooded crows, magpies, blackbirds, and chaffinches, as well as squirrels and bats.

Based on the municpality's analysis of the park, it is described as Bynatur, which is characterized by low biological species richness due to the lack of spreading possibilities, and the intensive use for recreational purposes.

18 | Kildevældsparken

Team IILLAA
Author Lazaara Ilieva
Theme Research
Date 10.03.21
Appendix 18
Page 2 of 4

Figure 3. Frisporet [10]

Figure 4. Vision of Kulturcenter Kildevæld [11]

Frisporet [9] [10]

As pictured in Figure 3, Frisporet is a free track, designed as a meandering activity band that runs through the north part of Kildevældsparken - a section that was not originally part of the park. It was built in 2016 in connection to the construction of Skt. Kjelds Kvarter, which was designated as Copenhagen Municipality's first Climate Quarter.

The focus of Frisporet is on nature, places to stay, play, learn and discover. There are several elements of the track that include a wooden labyrinth, old railway tracks and large wood installations. The railway track elements give direction to the path, while also reflecting the park's historical roots.

"It's also about working with nature and a nature-like park, compared to the original Kildevældsparken which is very classical, so it's more about free nature and biodiversity." [12]. Small hills, edible shrubs, climbing trees and a labyrinth of kvass fences help to make Frisporet a small strip of slightly wilder nature. In addition, the large sculptural tree trunks are evocative elements that are also home to rich insect life.

According to the development plan [10], the designated grass areas along the path are intended to develop into flower meadows so as to increase the biodiversity.

Kildevældssøen [2] [3] [10]

The central and largest element of Kildevældsparken is the lake, Kildevældssøen. The area of the lake is calculated at 1.3 ha and the average depth is estimated at approx. 2.3 meters. The maximum depth of the lake is estimated to be around 4.3 meters. Since the edges of the lake's bottom slope a lot - reaching 1.5 meters in depth at a 2 meters distance from the edge - the banks are stabilised with a wooden edge, which are in need of restoration. The water level in the lake varies very little from year to year as the source supply is large enough to keep the water level stable despite evaporation. Excess water from the lake is led to a sewer via drains.

The water quality in the lake is poor with high level of nutrients. Since it has no inflow from anything other than the underground aquifer, the nutrients likely originate from leaves, soil, bird droppings and precipitation. Another reason for the lake's poor water quality is that it is relatively deep and is protected from the wind, so that the water at the bottom of the lake does not mix up with the surface water. Thus, the water at the bottom is not oxygenated during the summer period, when the lake is usually green and cloudy due to planktonic algae, indicating the lack of underwater vegetation. Based on the municipality's analysis of the lake, the fountain in the middle of the lake, which aims to supply the lake with more oxygen, has only a small effect, and the biodiversity in the lake is considered poor. Purification and regulation of the water in the lake may be carried out if the purpose is to improve the water quality or the lake's flora and fauna.

Kulturcenter Kildevæld [10] [11]

Kulturcenter Kildevæld is a local and visionary project that aims to integrate culture, sustainability, learning and nature. It is envisioned to become a cultural meeting place that brings people together and forms the framework for a good and sustainable everyday life.

It is being built as an extension of Kildevældsskolen's North Building, and will offer 1,020 m² with flexible event rooms and movement facilities, including a library, gymnasium, workshops, café and a "climate room". It is envisioned as an integrated part of the school as well as Kildevældsparken. In an effort to better connect the school and center with the park, the iron fence that used to run the entire way along the path was taken down. However, according to parkfolvalter, Signe Dragenberg, the removal of this fence has since led to an increase of human movement around the bushes, thus hindering the development of the vegetation underneath the bushes. "It's a fine line having people close to nature, but not too close." [12].

Unfortunately, the construction process has been complicated and the center's opening has been postponed five times, originally scheduled for 2016. Nevertheless, acitivities have continued in and around Kildevældsparken, including communal meals, concerts, barter markets, network and dialogue meetings. These cultural events are seen as a breeding ground for the communities that are envisioned to grow large and strong in the upcoming culture center.

18 | Kildevældsparken

Figure 5. Kulturfestival in Kildevældsparken [7]

Figure 6. Avenue of linden trees (established in 1912) will be protected under the municipality's Wood Policy.

Conservation Conditions for Kildevældsparken [2]

In Copenhagen's Municipal Plan from 2011, Kildevældsparken was declared an 01 area: Institutions and Leisure purposes. The municipality's overall goal is to preserve Kildevældsparken as a publicly accessible park, with a content of elements that cover a broad target group, and to secure the park as a green breathing space for the area's residents.

Kildevældsparken is protected under the Nature Conservation Act, which includes a total protection for 10 parks. In general, the purpose of the conservation is to secure the parks, as well as to maintain and enable an improvement of the areas' recreational, landscape and biological values.

According to the conservation regulations, purification and regulation of the water level in the lake may be carried out if the purpose is to improve water quality as well as the lake's flora and fauna.

The City of Copenhagen has a strategy for biodiversity to stop the loss of biodiversity, and generally create space for nature both during construction and operation. Measures to help increase the biodiversity in a park with Bynatur, like Kildevældsparken, include the conservation of old trees and dead wood, local composting of green waste from the park's operation, or varied grass care so that areas with tall grass are established.

Strategy for Urban Nature [10]

The strategy for urban nature in Copenhagen was adopted in May 2015 and has been adopted to the most recent development plan as part of the municipality's work for a greener Copenhagen. The plan's vision is to create more urban nature in Copenhagen and to increase the quality of urban nature in Copenhagen.

In the strategy, the term 'urban nature' is an encompassing term that includes all living beings and plants that live and exist in the city. The strategy operates with the three main types of green spaces in the city, in which urban nature is found. The three types are 'Urban and street spaces', 'Parks and cemeteries' and 'Nature areas'. In addition, five quality parameters are defined: biodiversity, climate adaptation, functionality , spaciousness and care efforts. Kildevældsparken is in the category 'Parks and cemeteries', and the existing biological diversity is limited.

In 2016, the City of Copenhagen also adopted a tree policy with the aim of ensuring a prioritization of both new and existing trees in the city, without hindering its development. The principles of the tree policy are (1) Existing trees should, as a general rule, be preserved. (2) Particularly valuable trees must be identified and preserved. (3) More trees must be planted in Copenhagen. (4) Good growth conditions must be ensured for both new and existing trees in Copenhagen, and (5) A varied choice of tree species must be ensured in Copenhagen.

Users of Kildevældsparken [2]

Like the playground that is located on the west side of Kildevældsparken, the park is frequently visited. Most of the users of the park live in Skt. Kjeld's neighborhood. It is used for walking, dog walking, running, sitting in the sun, feeding ducks, among other recreational activities. Many go through the park when they drop off and pick up children at institutions north of the park. And Kildevældskolen's teachers and students use the park, mainly during sports lessons.

Once a year a big party is held, called Kulturfestival (Figure 5), which aims to strengthen the social cohesion of the local area, to make visible the neighborhood's associations, organizations and institutions to the users of the playground and park, and in this way promote networking, participation and volunteer work locally and more widely in Østerbro [5].

According to a user survey conducted in 2012, many of the 54 citizens surveyed appreciate the park, as it is, with its recreational functions in the green and its social opportunities. 90% of those surveyed especially like the path around the lake. Two thirds feel safe when walking, and 60 - 70% perceive the park as neither too dark nor too closed. Still, safety and accessibility are two of the recurring topics, either in terms of the depth of the lake and its steep banks, or in terms of the gates and slope of the paths, which can be a challenge for seniors or visitors with strollers.

18 | Kildevældsparken

Team IILLAA
Author Lazaara Ilieva
Theme Research
Date 10.03.21
Appendix 18
Page 4 of 4

Figure 7. Platform at Kildevældssøen [10]

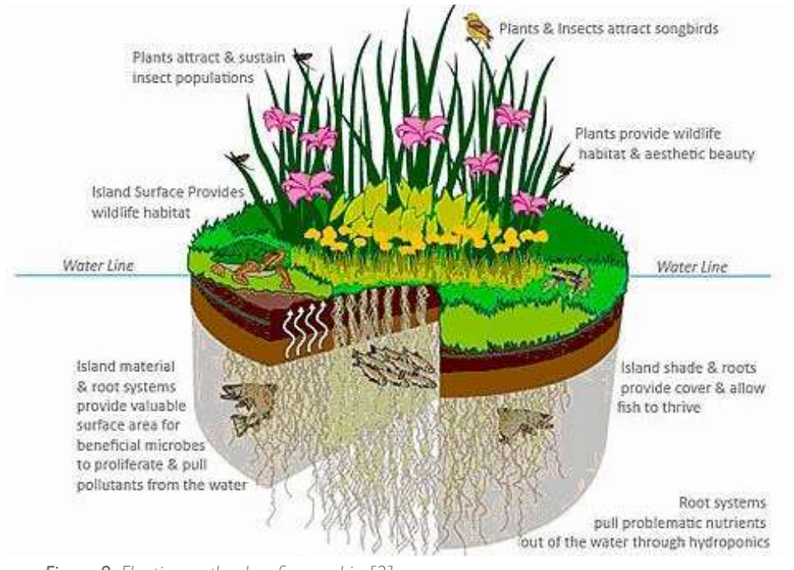


Figure 8. Floating wetlands referenced in [2]

Visions and Wishes for Kildevældsparken [2] [10]

According to the municipality's development plans for Kildevældsparken, the park's primary purpose of daily recreation for citizens as well as its lawns, paths, and plantings are considered central features that must be supported in future developments along with initiatives that aim to create greater biodiversity. The overall vision for the park centres around its identity as a small breathing space that offers a respite from the fast-paced city life (in contrast to the nearby Fælledparken, where there are football pitches, areas for petanque and installations that encourage many forms of physical exercise) and as the green heart of the neighborhood. Hence, calm recreational experiences and beautiful green spaces are considered characteristic of Kildevældsparken.

The development plans are considered to relate to the broader city strategies, which include the desire for green areas for the city's citizens, the strategy for biodiversity, decisions on green cycle routes as well as climate adaptation and urban nature strategies. The development plans also advocate for the integration of the surrounding educational institutions through initiatives aimed at the use of the park as part of teaching activities and as green areas for play and movement.

In particular, wishes for the park's development centre around the human users of the park and their recreational activities. For example, more seating and grilling opportunities are desired as well as overall improvements to the park's accessibility for people in wheelchairs or using strollers, in regards to paths, gates, and seating furniture. The narrow strip to the north, which has previously been a reserved outlay for road (disused part of Borgervænget), has been transformed into a cycle path, and will become part of Copenhagen's Green Bicycle Network.

Besides the intiatives that centre around the themes of recreation and accessibility, the development suggestions also refer to the park's landscape and nature, which are driven by both biological and aesthetic values. Strategies that concern the park's biodiversity mainly involve leaving dead wood in the green areas so as to benefit the existing wildlife, insects and fungi, while dead trees can be left in place as possible shelter options for birds and bats. Bird boxes and insect hotels are also considered as strategies to support the park's biodiversity

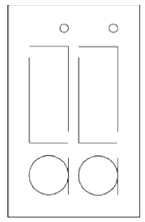
Improvements to the lake are also suggested. Regarding its recreational value, accessbility to the water is discussed so that the lake can be used by humans for recreational and educational purposes. Since the 2013 development plan, small platforms have been built around the lake (Figure 7). A desire for more vegetation in and around the lake is also discussed as well as improvements to the water quality. "Floating wetlands" are suggested as possible solutions to the lack of vegetation in the lake, which do not require the plants to be rooted at the bottom of the lake (Figure 8). However, due to bird feeding activities in the park, a disproportionately large amount of birds is being artificially maintained compared to the size of the lake. So, floating islands and plantings around the lake's shore would be trampled down and eaten by the many birds and thus difficult to establish. For this reason, information programs are also planned to disseminate information about the importance in halting bird feeding acitivities.

Additionally, natural elements are also being considered for the installation of play and fitness tools that inspire movement in different ways and challenge the imagination. In this way, some development initiatives look to combine both recreational and biological purposes.

References
[1] Københavns Frihavn. Retrieved 20 February 2021, from http://www.hovedstadshistorie.dk/oestervold-2/koebenhavns-frihavn/
[2] Københavns Kommune (2013). Kildevældsparken Udviklingsplan 2013-2018.
[3] Danmarks Naturfredningsforening (n.d.). Kildevældsparken og Genforeningspladsen. Retrieved 20 February 2021, from https://www.fredninger.dk/fredning/kildevaeldsparken/
[4] Kildevældsparken. (n.d.). Retrieved 20 February 2021, from http://voreshusertilsalg.dk/kildev%C3%A6ldsparken.html
[5] Kulturfestival i Kildevældsparken. (2016). Retrieved 20 February 2021, from https://ugeavisen.dk/oesterbro/artikel/kulturfestival-i-kildev%C3%A6ldsparken
[6] Steen Ravn Andersen (2018). Kildevældsparken. Retrieved 20 February 2021, from http://steenravnandersen.blogspot.com/2018/04/kildevldsparken.html
[7] Kulturfestival Østerbro (2013) Retrieved 20 February 2021, from https://lindgreiner.dk/gallery/kildev%C3%A6ldsparkens%20legeplads%202013
[8] Paldan, M. (n.d.) Grand Greater Copenhagen Route. Retrieved 20 February 2021, from https://cyclingincopenhagen.com/grand-greater-copenhagen/
[9] Klimakvarter (n.d.) Kildevældsparken. Retrieved 08 March, 2021, from https://klimakvarter.dk/en/projekt/kildevaeldsparken/
[10] Københavns Kommune (2013). Kildevældsparken Udviklingsplan 2019.
[11] Klimakvarter (n.d.) Kulturcenter Kildevæld. Retrieved 08 March 2021, from https://klimakvarter.dk/en/projekt/kulturcenter-kildevaeld/
[12] Interview with Signe Dragenberg.

19 | Insights from Workshop

Think Box #1



Team IILLAA
Author Isabella Ursano
Theme Think Boxes
Date 01.06.21
Appendix 19

1. What is a park?
2. Do you usually go to Kildevældsparken? If yes, what do you usually do while you are here? If no, tell us about a park that you frequent in CPH.
3. What do you enjoy about it? Do you see anything missing in the park?
4. What would you change about the park? Why?

Allan

1. For me a place to walk among green and blue spaces of semi nature. A place to relax. But also a place to make a run and bring the kids.
2. No, most often I make use of Kastellet, Østre Anlæg, Kongens Mave, Classens Have and Felledparken. For the same reason as mention in 1.
3. Love the calmness. The colours. The smell. And to see other people having a break --> More biodiversity
4. Nothing for real. But would like to expand the green park area.

Felipe

1. A place for people to connect with nature.
2. I usually pass through on my runs.
3. The nature and its peace within the city.
4. Nothing

Ilka

1. A green oasis , a place for play + contemplation. A place to meet, to connect w. Nature
2. I usually go to Fælledparken where my kids can play and we can have picnics - more free space
3. I would enjoy if there was more to explore, more diversity , a cosy spot to sit. After surrounding the lake there's not much more to see / explore
4. Some smaller paths, more small area, edible plants, wilder!

Julio

1. A place to go when you want to go outside close to the nature.
2. No, I usually go to Fælledparken. Where I mainly go to the skatepark.
3. More trees, there is a lot of football fields. Also, more places where you can do grills.
4. Soccer areas should be reduced.

Kasper

1. Green area
2. No.
3. Frederiksberg have.
4. Big, big enough for a long walk
5. I like the lake. enough benches to sit on and relax since it's not a huge park Enough trash bins?

Lars

1. A green oasis in the city .
2. Different ones: Faelledparken, Norrebroparken…
3. Flowering herbs and plants, wild areas, more "nature"
4. Introduce the above.

Nicola

1. Green area
2. No - Kongens have (Kastellet), Frederiksberg have, go for a walk, sunbath, run
3. Peaceful, nature, lake
4. Nothing

Sara

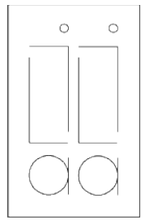
1. A piece of biodiversity in the city.
2. Yes, and Nordhavnstrippen and Faelledparken.
3. I enjoy the sound of other creatures (insects, birds). It's a quality that there is a lake
4. I would like for more areas in the Copenhagen parks to be "wild", less lawns and more "nature" on its own terms . Also more darkness/intelligent light.

Sophia

1. It's a place where all neighbours can enjoy different activities like walking, working out, picnics, enjoy nature. It also is very important to facilitate fælleskab in the community.
2. Yes, I come often for a walk, to meditate or have a videochat with my family.
3. It's a quiet place but full of life, it is less visited by people so gives you a feeling of an oasis in the city.
4. Clean the lake of the trash that unfortunately people throw near the dock.

19 | Insights from Workshop

Think Box #2



Team IILLAA
Author Isabella Ursano
Theme Think Boxes
Date 01.06.21
Appendix 19
Page 2 of 5

1. What is a lake?
2. Imagine that you want to spend a day in a nature area with a lake. Where would you go? What would you do for fun? What would you see?
3. List some elements you think you would see in that ecosystem?

Allan

1. Water environment naturally evolved or man-made. Connected to a water system somehow, small or change.
2. A forest outside of CPH. Ride a bike. Or go for a walk with the family or a friend. Look for what the nature brings to sight.
3. Algaes, frogs, birds, snails, different types of soil and plants, shade of light, + smells + of earth.

Felipe

1. An ecosystem that contains different animals, plants and microorganisms all interacting together and with the media (water).
2. Swim and hike around the lake. I'd be on the lookout for birds, trees, flowers, sounds and smell of the nature.
3. Water, flowers, animals such as birds, deer, etc.

Ilka

1. An ecosystem that is only partly accessible by humans. A source of drinking water for plants, animals. A place to refresh for animals + humans
2. In an urban context a place where I can have a picnic w. Friends, enjoy the view + sun In nature a place with shallow access, clean water, possibility to swim and do picnic, BBq
3. Trees, meadows, animals, berries … free access to the water

Julio

1. A body of water that has a significant volume.
2. I would like to go to a new place. Kayak or paddle boarding. I would see lots of fishes and trees and very few people.
3. Trees, fishes, plants, insects.

Kasper

1. Water area surrounded by land
2. Outside city area, to also explore animal life with the lake
3. Would not do anything extraordinary, but observe. Plants, animals, fish, birds

Nicola

1. Natural water reservoir
2. In Cph: Castellet / Østerbro Anlæg taking a blanket and laying nearby reading a book/ "swimming"/"water sports"/ animals - ducks/ swans/fish/ picnic/bbq / outside of DK - Austria, Slovenia :)
3. Watergrass + many flowers :), fish, trees, birds, insects, mushroom

Sara

1. An ecosystem in water? Self-sufficient.
2. I would go to a Swedish forest-lake to swim.
3. Seagrass, insects, fish, birds, trees, stones, sand, clay

Sophia

1. A big body of sweet water that hosts a full ecosystem.
2. I would go to the shore, maybe find a place with many tree roots to watch the little fish animals.
3. Source of food: plants, insects, animals, algae etc.

Discussions during the workshop

"I was actually at this seminar the other day about urban greening and they were asking for ideas of activities and I actually suggested biomimicry and started explaining it - I felt so clever!" (Emilie)

19 | Insights from Workshop

Team IILLAA
Author Isabella Ursano
Theme Think Boxes
Date 01.06.21
Appendix 19
Page 3 of 5

Think Box #3

1. Based on the Spot the difference activity, what is a problem that you see in Kildevældsparken?
2. How would this problem affect you and why do you think it's important?
3. Should Kild. resemble a natural ecosystem? Why or why not?

Allan

1. Made for human activity much less for nature
2. I would like to make a change of the park. Feels like it's the right thing to do.
3. At least move toward a natural habitat - e.g. with help from humans :)

Emilie

1. There missing a lot of links. It difficult for the biodiversity to "live". It's a problem for insects and so on.
2. For us to live, we need the other elements in the biodiversity ecosystem.
3. Yes.

Felipe

1. Lack of biodiversity in the lake and the "blockage" of the lake.
2. It impacts the entire park and per consequence the human interaction with it.
3. Yes, as humans need more contact with nature and also to provide better living spot for life of other organisms.

Ilka

1. Wooden banks / steep access to water work as a barrier between land + water + species. No vegetation towards / inside the lake viceversa, reduces possibilities for plants, animals (humans)
2. It affects the water quality, the biodiversity, the habitats for insects. Creates a dynamic of water quality getting worse + worse
3. Yes. Support biodiversity + make the path more interesting for humans at the same time.

Julio

1. A lot of human interference that affect the park.
2. Because, it doesn+t make a good place to live.
3. Yes, because we need an organic lake. Not just a lake that is an accessory.

Kasper

1. Lack of animal life
2. More "polluted" / trash
3. For this park specifically, mostly for the aesthetic

Nicola

1. Too artificial, plants missing
2. Does not impact me personally but it's important for the "nature" left in big cities like Copenhagen. Green areas are key
3. Yes - why to have a lake when it's not bringing anything good to the surroundings and nature

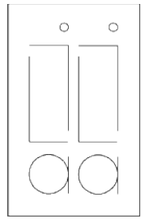
Sara

1. To little nature is "left alone" - too steep border / too little gradients from land to lake. Too little nutrients allowed to grow in the lake.
2. With the huge biodiversity crisis, it's necessary to rethink the way we design city parks and provide space for more species.
3. Yes please :) We need to use our few areas with nature in the city to provide for more biodiversity.

Sophia

1. That all the attention from the government was focused in the aesthetics and not really thinking in the ecosystem and wildlife.
2. I enjoy the nature in this park but it will keep being affected with time, so it won't be a nice place to hang out.
3. Yes it should, because it's a way to give back to nature after the damage we have caused.

19 | Insights from Workshop



Team IILLAA
Author Isabella Ursano
Theme Material
Date 01.06.21
Appendix 19
Page 4 of 5

Feedback sheets

1. What do you think about the workshop? Was it well structured?
2. Did you learn anything new?
3. Did it change your perspective about urban nature?
4. Would you participate in a similar workshop in the future?
5. Suggestions:

Allan

1. It was a good presentation of the concept- and fun to be sitting in the park trying to both vision and generate ideas around the concept "what is a park" and "what is a lake". It worked really well that you started with a common presentation to the topic so all participants started out with a common ground.
2. I realised that it seems easy to bring different people together, who share some interest in the same area. Our team was great to work together. And there was an overall good chemistry/atmosphere - and the weather was great today.
3. Maybe a little bit. But more importantly, it seemed like a good method you came up with in order to bring people together, create ideas, and show that change is actually possible through practical work building the floating island. That was fun.
4. Sure. But rather I would recommend the workshop to other friends and other families in our neighbourhood.
5. Great to see this type of partnership between Miljøpunkt Østerbro, Kultur Ø and the university. Great job today

Felipe

1. The workshop was very well put together. All the material you presented was to the point, it did not feel like a class. The interactions within the groups and in-between them enhanced the workshop. The hands-on part was also a highlight.
2. Yes. Well, first it was good to revisit some of the learning from the Master's and the new material for the Biomimicry; the way on how to work together with nature also how to draw inspiration from it was interesting. Lastly, I liked the oval diagram that shows the process and how to implement it.
3. Indeed. It showed that more than just a park to walk around, it is part of a much more complex system; that the layperson takes for granted. Eye-opening.
4. Surely.
5. Not a suggestion, but more of a comment: The engagement of the different actors (especially from the neighborhood, municipality, Lars, etc) was a key feature. It enhances the overall experience with different opinions that matter for a successful project.

Ilka

1. The workshop was fantastic, well structured and very engaging, great balance of theory and practice + interaction
2. Yes. It gave me a good introduction to biomimicry and of course now I know how to build a floating garden
3. It broadened my perspective on lakes + their different microhabitats
4. Yes. And I would love to recommend it if you did it again
5. If you could share some of the charts / handouts (digitally) that would be great

Julio

1. Yes, but I think the visual aids needs to be bigger.
2. A lot.
3. Yes because now I see all the details behind the nature.
4. Yes for sure! :)

Kasper & Nicola

1. Yes, I think the workshop was structured in a good way. [...]
2. I learned a new word :-) and I learned about the ecosystem. I learned how it's all connected and especially how "small" details in a lake play a vital role to its ecosystem, such as an embankment. I would maybe have liked to get even deeper into the biomimicry topic. [...] Perhaps i would have liked getting more into details about what kind of industries are using biomimicry and mostly benefitting from it. Or also something about the whole idea phase when reaching to solve a problem using biomimicry. Is it always just designs from nature that can inspire? Or is it also on a theoretical level? If biomimicry is so great, which it obviously is, then what is it that hinders us from using it more than we do? Knowledge? People are not enlightened? Costs? Design problems? Lastly, maybe get into discussion about all the benefits about biomimicry and at the same time talk about how biomimicry might not always equal sustainability and eco friendliness. However, if all this is not in the focus area of your master thesis, I understand why it was not included.
3. Yes, it has taught us that there should be more thought into designing and building parks in regards to nature in order to sustain healthy and functioning ecosystems.
4. For sure! It was my first workshop of this kind but I enjoyed it. Would like to learn more about local issues connected to nature\ Earth\sustainibility
5. Most suggestions already made above, but honestly i think it was a great workshop. The hosts seemed very interested and passionate about the topic which only made the audience more interested. They seemed eager to share their knowledge, were very prepared and very kind. No lack of presentation skills at all. Speaking loud and clear and making the topic understandable for everyone. All in all, very very very excellent job!

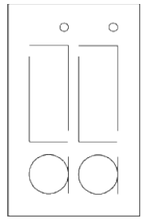
Sara

1. Yes, I was impressed.
2. Yes, the workshop was inspiring in how to help people reflecting on the urban nature in their local community, using ersonal references and reflecting on ones individual reletionship to nature (for example by being asked to consider where ne would like t visit a lake, and what one expects to find).
3. It increased it.
4. Yes

Sophia

1. It was amazing! Yes, because you guys initiated the reflection and mixed the theory so it was easy going. It has definitely exceeded my expectation and my view on nature in the city.
2. Of course, I have a complete different approach to parks and nature areas.
3. Definitely.
4. Yes please, here is my contact info [...]
5. Do more workshops/sessions of this kind to actually make a change with the neighbour's help.

19 | Insights from Workshop



Team IILLAA
Author Isabella Ursano
Theme Feedback meeting with collaborators
Date 01.06.21
Appendix 19
Page 5 of 5

Email from Mads

"Hi, I received your distributed pamphlet the other day in Kildevædsparken! Your initiative is very welcome and I can see that something has already happened; the floating islands in the lake! Great to see! Tell me if I can in any way be helpful with other initiatives! I think there should be a fringe of wild flowers (wild flowers and the like) layer lake shore - e.g. in a 1.5 m. wide belt along the water's edge.
Good luck with your project! :)
Dbh.
Mads"

Allan reached out to Miljøpunkt after the workshop

Allan: "Good workshop and it would be nice to do something similar for children"
Sara: "It was a very nice way of engaging the participants - efficient - asking where would you go made participants relate to a piece of nature that they know"
"It was a good way to reference - it should be translated in a similar workshop for children" - "this guy has a lot of ideas - not that is a bad comment"

Farm for animals idea

Allan suggesting this because there are some places already in CPH that have this and having these animals is to explore what would it do for the children, but also connecting people with nature

Angry lady - story from by passers

Emilie: "In the flyer / poster, it mentioned the local community, so she got mad because she didn't hear about it. She was mentioning that it was her park and she expected to know. Also, the workshop was in English so she was also mad about that"
Sara: "On the other hand, there are also non-Danish people that do not have many workshops to join, so I think that it was a nice opportunity for them.
Some people think that they are entitled to have all workshops tailored for them, "my needs everywhere" especially my generation and up, so do not take it as a critique for your workshop - it is just the way some people are. "
Emilie: "It is difficult to communicate in a way to reach everyone. People forget that they should search for things themselves as well and not expect to know everything somehow."

Length of the WS

4h is ideal for these types of events
2d is too much

Leaflets

Emilie: "It was nice with the leaflets - a good way for people from the park to feel involved"
Sara: "They were missing a part that says what to do if you want to join more activities, like for instance sign up for Miljøpunkt newsletter."

Explanation of floating islands in the park (future)

They could have a QR code linked to an article on Miljøpunkt Østerbro's page
People didn't read the poster (too much text), so make sure to put maybe just a photo and little text + possibility to click / access a bigger article

Monitoring the floating islands

For pictures, we could use Instagram
For observations, we should add participants in the FB group with the green network

Future mobilization

Someone should do the workshops
Emilie: "we will help, but we also need to figure out how to make the relationships between citizens and the floating islands. Maybe the workshop participants would like to take charge in continuing this kind of workshop."

Money
Emilie: Kulturcenter Kildevæld will sponsor this workshops, but in the future, it should be the Lokaludvalg
Sara: We could back it up also - maybe involve the schools in the future
Lars: You are so cool, very organized
Sara: Next people doing this would need the same communication and organization skills

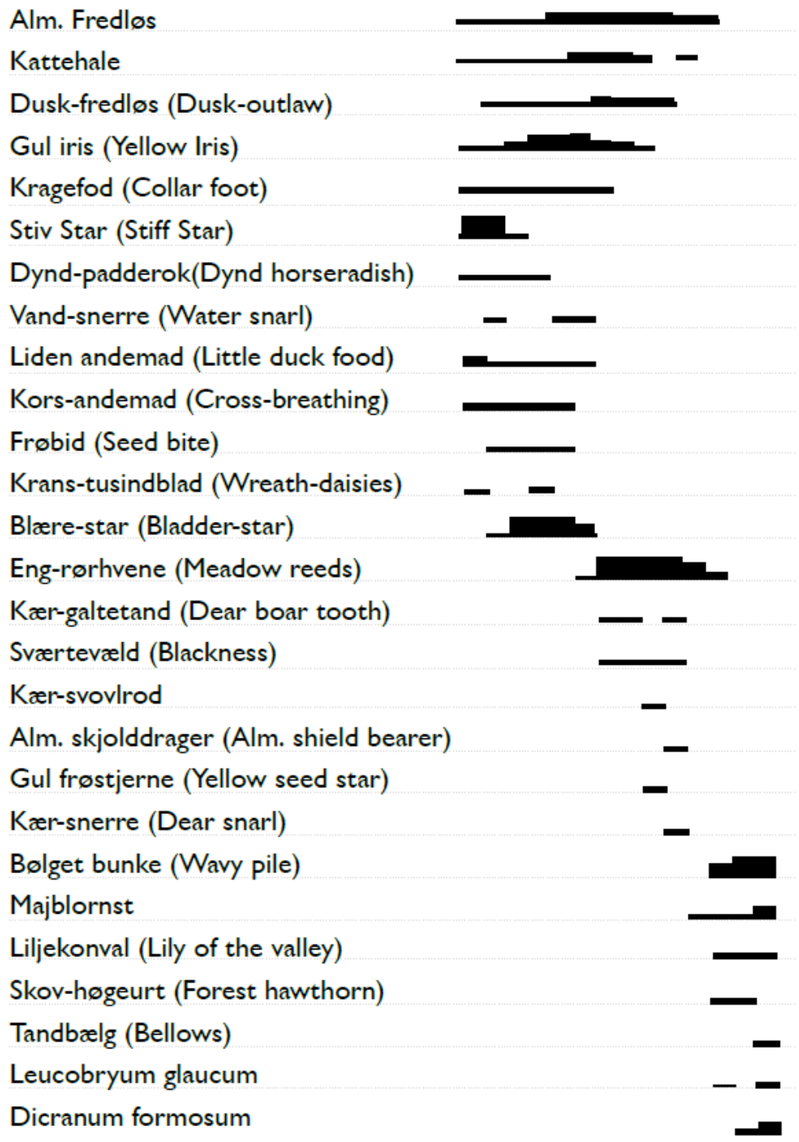
Feedback (what went good & what to improve)

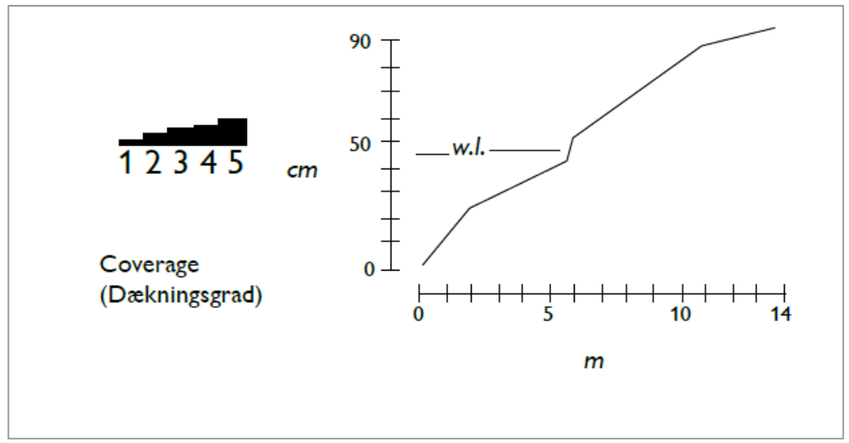
EMILIE	+	People were really active and that's not always what we see In our past WS wouldn't have stayed longer than the time frame scheduled on the event It was really nice the fact that you could build the prototype as you wished People felt doing something good for the earth It could be an idea to create the floating island once a year with the school
	-	It was nice to hear that people stayed until the end, that's fine, but it took longer than it should have The length of the WS has to be more clear Maybe it would be better to make a WS focusing just on the islands The target could be kids Take more the lead Maybe it would've nice to tell them to stick to the structure and follow a guideline (IKEA guide) You do this for your report and then who takes the responsibility?
SARA	+	People are ready to be convinced → politically is a very important aspect We need to add momentum for people to understand qualities of urban nature - change aesthetics values
	-	Prepare some of the metrics, materials, parts before the WS, so it takes less time
LARS	+	The end point was to make the floating island It was more a cover story, than It was an innovan method to use with the participants It increased the awareness of design with and for nature, but also explore this relationship between culture and nature - It was well integrated with the steps of the workshop
	-	I would've loved to have more time to expand and explain the Life Principles and how nature is using the resources, but for this we should have booked something out of the programme Build the elements of floating islands before the WS Biomimicry aspect: " I don't think we could have had more time for it"

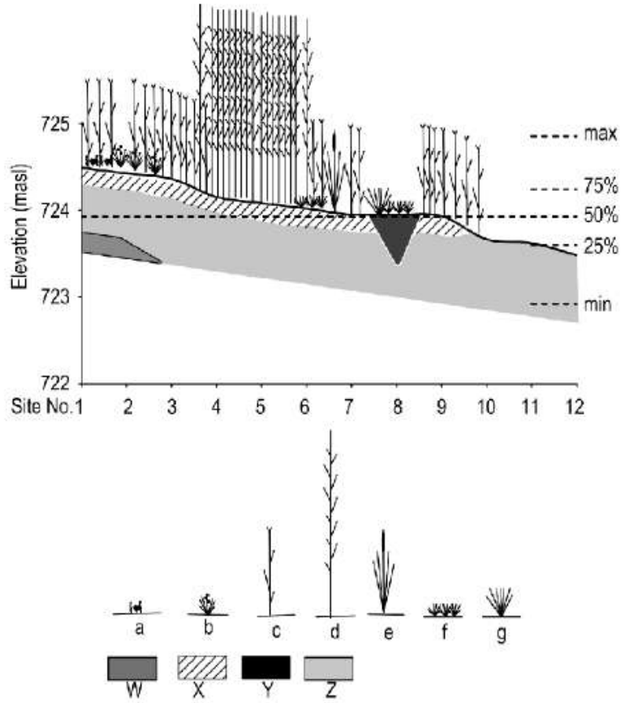
20 | Gradient

Team IILLAA
Author Isabella Ursano
Theme Research
Date 01.06.21
Appendix 20
Page 1 of 1

Here below the graph showing the gradients characteristic in lakes which Lars, the biomimicry expert, shared with us in a meeting previous to the workshop. This data helped us explain to participants the varying gradients characteristic of lake banks that provide a range of micro-habitats for various species.







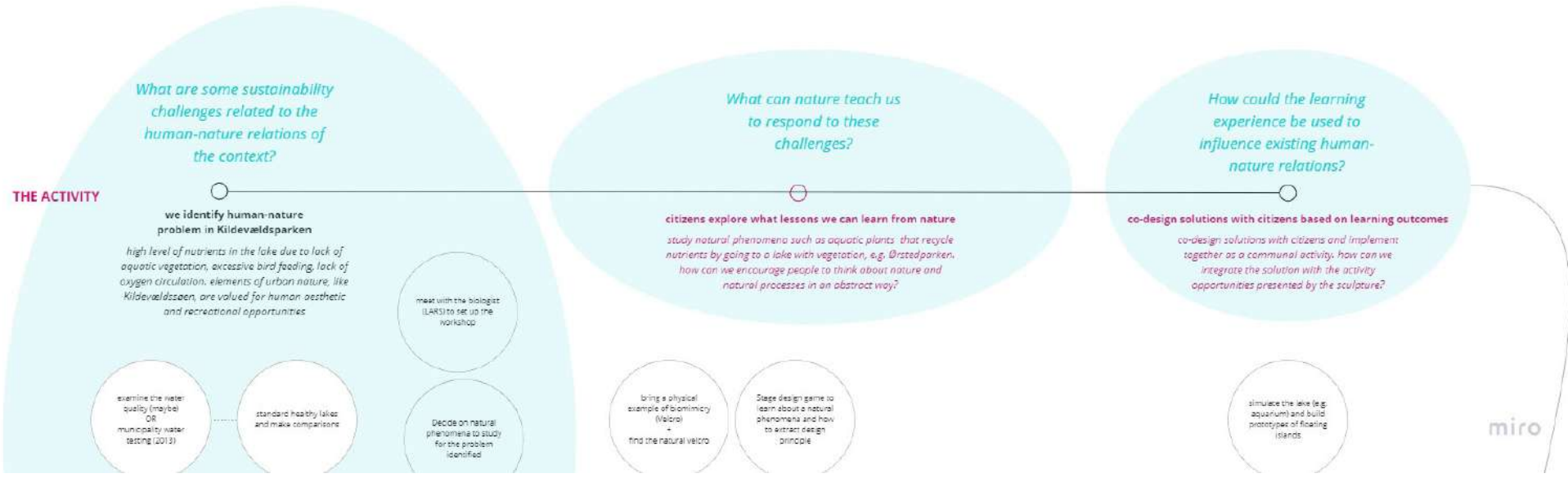
References
Krolová, M., Čížková, H., Hejzlar, J., & Poláková, S. (2013). Response of littoral macrophytes to water level fluctuations in a storage reservoir. Knowledge and Management of Aquatic Ecosystems, (408), 07.
Petersen, P. M., & Vestergaard, P. (2006). Vegetationsøkologi. Gyldendalske Boghandel, Nordisk Forlag A/S, Copenhagen, 1-189.

21 | Meeting with Emilie

Team IILLAA
Author Lamiita Traista
Theme Empirical investigations
Date 13.04.21
Appendix 21
Page 1 of 4

The insights are from a meeting conducted on 13.04.21 with Emilie Bernt Haag, culture and project coordinator at Kultur Ø, to discuss practicalities for the workshop.

Presentation of the chosen biomimetic process for the workshop on Miro Board



Lamiita: All right. Yes, so can you can you see the screen? Yes, Perfect. OK, so basically from the three activities that you recall that we had more alternatives, yeah, then we kind of discussed that it would be better if we kind of involve the community in the learning from nature part and then in the end with actually doing something physical. So both Signe and Louise suggested that it's better if you have something in the end like to show you what happened there. Yeah. So then.

Emilie: Yeah, yeah, yeah, yeah.

Lamiita: They were both fond of the island, the floating islands, and then we had some concerns, I mean, they also pointed out that it might be something with the permissions that might be a bit more difficult with the floating islands. But I mean, we were willing to try to see what goes around. She mentioned something about the if there are organic materials that she a bit concerned that might not be allowed because they can dissolve into water. And then in that case, we were thinking maybe to just simulate the lake with some floating pool or something.

Emilie: Oh, yeah, OK. Yeah, to make the workshop to see what is done then. Yeah. That's a good idea.

Emilie: And maybe get the permissions afterwards. Yeah.

Emilie: Yeah, but I think if she really liked the idea, I think she can hopefully, I don't know, but maybe get the process to to go further. No, but but she knows best.

Isabella: Now, just as she pointed out, like all the what we have to do, all the steps and everything, so we've got to from today start like asking for this association, whatever it is for the for the permissions and everything. But at least by doing this small pool kind of aside, at least we start with with the process or at least we show her what it's the final result or at least what we were thinking. Yeah. Who. You know, and so then we've been trying to figure out how to or just to plan how to actually go about it. So we're going to meet with he's a plant biologist and the biomimicry expert guy from Copenhagen University. And I think he's just stopped working there. And he's going to do work. He's going to continue with biomimicry. So we're going to meet with him today, hopefully Wednesday. OK, we have to right down the names: Lars and Lasse

Lazaara: So we're going to meet with him tomorrow, this week at some point. And we're going to see if maybe he could be also the biologist, like the expert who would understand or would who would have like kind of the more technical or biological information about the natural phenomenon that we're going to study, which we think we were talking about it yesterday. And we think it makes maybe a bit more sense to for us to choose the natural phenomenon to study rather than have the people figured out because it might be a little bit difficult. Yeah. Yeah. And so then the the role of the biologist, whether it will be this guy Lars or not, will be a bit more clear. What what kind of information like he or he or she has and what their role will be. So I think, yeah, we were thinking maybe to kind of keep. Make that step in the process ourselves and then the people are there to kind of like explore with the biologist.

Emilie: I think that's a good idea, OK, because of course, it's always nice to hear what the citizen thinking and how they understand it. But what I think this about biomimicry, I can say, though, I mean, it's it's a new way of thinking for a lot of people. So it can be too abstract. I think I think it's better to to try to find a way to describe it. So people are understanding and then it's just really good to have a physical thing to do it with, like the islands. So. So I think people. Yeah, I think that's a good way.

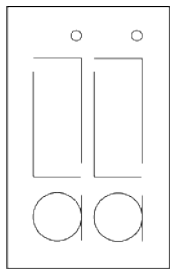
Lazaara: Cool, and then we're not sure if we should maybe split it up into two workshops, so the exploring with the biologists, like really learning about this natural phenomenon, which is wetlands, how they work, how they cycle nutrients, you know, to help the lake, whatever, whatever, and then have another day where OK, from the previous workshop, we've gotten like the main principles of how a wetland works and how X, Y, Z, whatever, and then the next workshop is OK. Now let's let's imitate it, which is like the ultimate biomimicry, the mimicking part. And then we bring all the materials and and whatnot. Or we could just do it all in one day. We don't know if maybe I don't know. From your experience, is it is it feasible to have people in one workshop and then say, OK, like you have to come to the next one? You know, like what they are, you lose them?

Emilie: Yeah, it's difficult to say because if they really think it's interesting, they will come. But but in the other way, it's it's always nice to to have to learn something, to discuss something and then do it. And that's just really nice in one workshop, I think. I know it will be it will be long or uh and of course maybe you can learn something. Someone will say, OK, this is not for me, blah, blah, blah. But yeah, I can understand why you're thinking in two and maybe that will work. But, but, but I think it would be better to make it one. I think it's easier to, uh, to sell it to people to say, OK, learn about this. And then we also go out and work with our hands and understand it because, uh, yeah, I think if it's possible for you, if you think it's possible to have like a a two hour workshop or a three hour workshop or something like that, I think it can it can be possible. And then you need to figure out if it should be. For what is the H a is it families or is it not families, is it. Yeah, and so on. And you can also maybe make an workshop for four children with the parents and then for other grown ups, because that could be interesting. But what's what is best for your assignment, I think.

Lazaara: Yeah, OK. I mean, we we discussed that briefly yesterday and we kind of said, like anyone is welcome, but maybe I guess. The approach to this or to to doing the designing the activity really changes if it's going to be children. So I guess

Emilie: and the way you need to communicate and so on will be different if it is different. And I think it could be really nice to have to have a workshop where it's not for children because then you will engage people that will be interesting in this and and will go higher than just making urban garden. You understand? So and I think that's the really interesting people if we can get those people. But it also will be interesting with the children, and I think it could be a workshop that a lot of families could it could see as a fun thing and a learning thing for our children and so on. So so if it's possible for you, then you should maybe make two workshops and then for the children, it should be, of course, shorter and and the information should be a yeah. In another way. So, yeah, yeah, but but it could be really. Yeah, could be really cool. But if you only have time for one or you just want to see, OK, would just make one, then I think you should do it for a four, not children. But you can say everyone is welcoming but but it will be on this level or because then, then families can of course come but then they know OK, it's not a family event. Yeah. I think

21 | Meeting with Emilie



Team IILLAA
Author Lamiita Traista
Theme Empirical investigations
Date 13.04.21
Appendix 21
Page 2 of 4

that's that's nice.

Lazaara: Yeah. OK, ok. And for this invitation, you know, where we kind of broadcast or whatever or advertise this workshop, do you have any tips for how to, you know, to hook people or.

Emilie: Yeah, it's always difficult because sometimes you can we can have an. Event that for me, it would be like, OK, you want to come to this and then there are three hundred people and they will be OK. This is the most special thing. And then it's not go out. Yeah. Around people or a or we just hit a day where there's a lot of other things and so on. But I think we will make it, we will make a Facebook event and put it on our home page and so on. And we can make it in a cohosts so it can be you making it and then make I don't think you will could make it all of us. I can make it and make my point as co-host and maybe also see this. I don't think they have a Facebook page, but but we can try to, if more are a co-host than it's it's going more out and it's really good to have point on it. And then we will make some. Yeah, some some shout outs and communication about and then we hope to be able to come. And I think maybe we should invite people we know could could see some interesting thing. And it's like we have a beautiful girl here like St. Scott and they are association and I think they will think it's interesting to come and and so on. We have a different then mix the two up fundings for any if you know them, invite them and ask if they want to be a part of it and so on. And then we need to figure out how many people are we allowed to be because of Corona and how many people is it possible for for you to handle? Because it could also be a workshop where we we put it out in the open and we we show that we are going to do this, but maybe it's only for maybe for you.

Emilie: It's more interesting that it's just like ten people and they really learn this and we make them to kind of ambassador for the Green Network or something. Yeah. So so you know best what is possible. They can we have 50 people if they were not Corona and. Yeah. And so on. Is it easy to to stay in there and until about of course the information will be easy to be a lot of people. But what about the workshop? Is it possible to show and then everybody can do it by themself, or is it important that the people out there. Talking together and, yeah, a coworking and so on,

Lamiita: with the current COVID situation, do you have any like you're saying, it's better in may, is it because there's going to be more allowance?

Emilie: It's because the 6th of May there will be a big opening and so small things are allowed there. But when we are outside, it's it's better in a way. But I think we still need to check up on that. But I think it's we still only need to be 10 people if we outside. I need to I will check up on that because the the restaurants are allowed to open for outdoor around the 20 of April. So I don't know if. If they open more people there. Yeah, but if you do it, I think if you can. If you can postpone it as much. Yeah, and then and it still makes sense for your assignment in.

Lazaara: And then for you and I mean and Louise, for example, would would you guys come and then and just kind of be there to observe or would you maybe, like, put on like a citizen hat and just be part of it and see from their perspective what it's like? Or or would you just not come and just like have us tell you about it and maybe record or take pictures if it's if people permit us to.

Emilie: I would really like to come and I hope it can it can make it can happen for me with my schedule and so on. So I plan to come. And if you like me to be a citizen to do that, it could be. A fun way for all of us to experience how can this be, but I can also just be there and I will you know, I will observe anyway.

Isabella: Yes. Yeah.

Emilie: So so I can be a participant and. OK, but but if there are a lot of participants, then. It's maybe better that I will not be so we can we can look at that, but OK, but I think it's really interesting for me and Louise, it should be a part of it. And to see how can this kind of workshop work? Because it's so so I. I think also, Louise, would want to be a part of it.

Lazaara: OK, great. We're very happy to hear it. And yeah, I guess it does. I think I mean, we have to discuss. But I would be so scared if it was like 50 people, you know, because yeah. Just to kind of like not bite off more than we could chew or whatever, you know, to kind of I think. Yeah. Not to have to too many people just so that we could kind of control the situation a bit easier because. We're being experimental, so there's a lot of kind of non controlled elements in the actual workshop, but. I guess also Corona, willing we have to kind of always have that limiting factor. Yeah.

Emilie: Oh, great. I want to also say I think right now we just have this Facebook page you heard about and can post it in there and we will get people from there. And there are different green project groups so we can put it in there. So I don't think it would be a problem actually to get people if we are communicated in the right way. And you also need to figure out is it in English or is it in Danish? And because, of course, I talk with actually a lot of people for this practice in English. But there but there are also people that will not come if it's English because they're not feeling comfortable with people in that. But but when you are improving the workshop, it needs to be in English. So if you understand. But but but it can also be that that you are. Of course, we need to figure out with Lars or Lasse if the workshop will be in Danish or in English?

Isabella: We don't know yet, but that is a good question, because if they of course, I don't know, maybe they they talk in English. But when they explain if it's way more direct and more clear to speak in Danish, you have to figure that out, I guess.

Emilie: Yeah, yeah, yeah. But otherwise, we can also see if we're going to figure out that you were speaking English and I will translate or another person will translate or something like that. But that's not possible. I think if it's for like half an hour or an hour where we talk about it, it's more like then to take the plans and do this and and so on. But we are in Denmark and most people can speak English, but there will always be older people were like, no, no, we are Denmark, so we need to speak Danish and so on. But maybe it's not a problem. It's just that you think about it because it needs to be clear even.

Lazaara: And yet. OK, yeah, yeah.

Lamiita: And then I was also thinking, so since we're kind of planning this like a rehearsal for when that installation will be used there, like a way to you think we can leave things in the park, like the way you would do it around the Kolonihavehus thing. That's going to be symbolic just to show what we've done, the process maybe.

Emilie: Oh, yeah. When they come through the park. Yeah. Yeah. In the park, we need to check with Signe that otherwise we can talk with, with any from the playground and, and see if she's interesting to have some of the models also on. But that's also I think that that also how big are they? Yeah, but it is really interesting to that people can walk by and say, OK, we're working on this, but you need to to to speak with Signe about that because you know what is possible.

Isabella: The know and I also have one question, but yes.

Emilie: Because I think it could be really cool if we can figure out a way to it to film it or something like that, or maybe you can we can figure out a way that we just take a picture at the day, but then you make an A and workshop at home where you do it, where you film yourself, because then we can we can put it up on a homepages and Facebook pages and see, OK, we're working on this at the Kildevælds Lake and so on, especially in these times. I think it could be nice. And then you can also maybe use that for your assignment to see people's response on it or something like that.

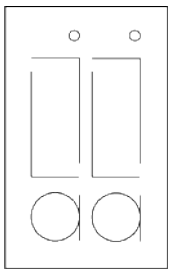
Lazaara: And then maybe that part could be we could do an English version. And then one of our friends who's Danish could do a Danish version because it might be a bit more easy to plan it out and then OK.

Emilie: And then and otherwise it's just in English. And then if you have it.

Lazaara: Yeah, yeah. OK. And and then would that would it make sense to do. For that part, like a like also like a step by step of how to actually to make the thing.

Emilie: Yeah, I think that could be a nice, um, a nice way. I don't know how, but but. Yeah, but we have some. Streaming opportunities, but but this is a little bit difficult, but I just moved the department, so and in my other department there was a lot of, uh, technical persons and then they have a lot of things to do this. And I can ask if we can borrow it, but otherwise we can just do it with the iPhone or something like that. Okay, that's totally fine. But it could be so cool actually do it. And also, if you only want to make one workshop, then we can make this workshop thing for children also to say, OK, you can at home, you can do this or you can do it and put it in the Kildevældslake or something like that. So there could be a way to to do it. If you can see it's not it's only possible for you guys to make one workshop.

21 | Meeting with Emilie



Team IILLAA
Author Lamiita Traista
Theme Empirical investigations
Date 13.04.21
Appendix 21
Page 3 of 4

Lazaara: Yeah. Makes sense. And then one or two things. One is, do you know, we're wondering if there's any opportunities that we could maybe take advantage of from the recycling station just regarding materials and like this kind of thing?

Emilie: Yeah, I think it's possible. I'm actually in dialogue with them right now because of the sculpture. And I know from Thomas Dambo he is using materials from their station. So I think a. I will yeah, my boss just write me actually about that, so I think I can give you her contact and then you can try to call her otherwise just yeah. Find the it's the wall. The name for the for the funding station is all the recycling station. OK, I think you can find the number at the Internet and say you make this project and you can say you make it with Kultur Ø.

Isabella: OK. Yeah, just because it would have been it would be nice to know that everything is kind of connected and it's right there and everything, what we could see if we can grab something for the structure or

Emilie: it will be so cool that it's actually also our hope with the sculpture that that the recycling station will be our. I don't know the name in English, but in Danish it's called [..], like a smaller recycling station where you can come and switch things and and also come in and use the materials. And that's what we hope is going to be possible. So you can be outside where the sculpture and have a workshop and you can see, oh, I can just go in here and get the materials to make these things. So so there could be so cool that that this could be actually an example of how you can do it.

Lazaara: OK. Be nice. Yeah, I guess it depends on them, the access to it.

Emilie: Yeah, but I can I can figure out.

Lazaara: Yeah. Yeah. So in the future, you would be ideally something that's a bit more open where people can go and and choose and take and it would be like a in the recycling station. Yeah. And that the ideally in the future that the recycling station will be much more open for the public in some way.

Emilie: Yeah, we hope. And we just figure out if it's the plan that it should be or if it's just some people who talking about it or. Yeah. So so right now we figure out if it's possible because that's our hope that that is going to be a more open. OK, yeah. We like.

Lazaara: Very nice. Yeah, one of our one of our supervisors, we were reading one of our paper, this is just kind of random, but they were they were doing like a design, this democratic design experiment with recycling stations in some square somewhere in [..]. Yeah. Yeah. Um, but yeah. So they did like a recycling station where the recycling collection point was much more like a recreational thing. And people like to go and maybe choose stuff, but like also hang out in this kind of thing anyway. That would be kind of nice. Yeah. To integrate into that because then like the idea of like circularity in circular economy kind of gets you into it. But I am sorry, one one other thing or at least that I can think of right now is that for these floating islands, the plants that need to be in it are very particular because they need to be aquatic plants or ones that one that we know that they won't, like, be problematic, like they won't become invasive species and ruin everything. And yeah, I mean, there's other kind of factors that we have to kind of consult with the biologists or ecologists, but we're not sure if we could just get them already grown or we maybe have to just make the template and then provide the seeds maybe to you guys to plant or to give even the participants to plant at home and then grow them a little bit and then put them in the things. Yeah. So maybe that's something we have to consider. So maybe at the end it won't be like the finished product because maybe a bit of time is needed for them, the plants to grow. If that's the case, then I guess maybe also in our in our your idea of doing the the workshop at home after we could show then after it's grown what to do, how to put it in or something like this.

Emilie: Yeah. So yes, maybe in the end it won't be like a completely finished yet, but we can figure out and and if you Signe and Louise, did they talked about funding for, for the project? what did they say?

Lamiita: they suggested to call this biodiversity fund. And then it was a deadline until the 18th of April. So we just contacted the person from there yesterday and we're waiting to see what's required.

Emilie: And do you know how much you need?

Lazaara: Not at all. Honestly, we don't talk about money at all, no. So, yeah, maybe we could calculate because that's probably part of the application process. OK.

Emilie: Yeah, but it's just that. Yeah. Let me know when you know how much you need and then we can figure it out because maybe I can also find some money from. My budget, because right now we have some money and normally we don't, and we allow to use the money if it's just an. That's sustainable, but sustainable. Thank you. In a way that normally would be like a I can fund some money for you because then we can figure it out. You need this money to build up your organization or something like that. And then after some time, you can do it by yourself with like a ticket money and so on. And I know this is in another way, but but for us, it's also really interesting and and a good project. So I can figure out how to find some money. It would not be like a fifty thousand crowns, but the but the but yeah. So so let me know what, what you need and then, then I, I think or hope that I will, I could find the money for the project.

Lazaara: OK. OK, thanks a lot. Yeah. We're in school. We absolutely have never thought in any project about money and what it requires. And we're always like this the economic part of the project. Yeah but let's just dream, you know,

Emilie: it's just always a thing that really can can mess up the project because sometimes it's like, OK, but we need these plans and it costs a thousand crowns. We don't have it. So what do we do. And so, so figure out if it's possible to buy the plans where they are finished and what would that cost? Maybe it's cheap, maybe it's really expensive. I don't know. And yeah. And about the island things. And I know when you talk about plans, it can sometimes be really cheap and sometimes really expensive. So yeah. So of course I am. Yeah. I just maybe it's possible to get the seats and then there could be the workshop where you planned it and we need to have it somewhere or they get it home and then we have a small amount to, to make in the prototype or something like that.

Lazaara: Yeah. Yeah, yeah. OK. Brilliant, yes. And do you have any more or any more information about how the Dambo project is going or anything?

Emilie: um, it's we just had a meeting with Mimi yesterday and we were talking about it, but it was just like we needed to be more sculpturally, like more fun to look at. And that be right now. I didn't get to see a sketch of it that it shows. No, no. OK. They try to see a. OK. OK, here, um.

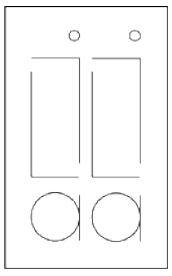
Emilie: Can you see it?

Emilie: Yes, right. Can you also see my this? Yeah, yeah, um, but the thing that we took with me me about yesterday was that I don't want the fence to be like this. We need the fence to be a on the whole garden thing, OK. Or to be like more like a portal where you can go into this green area or something like that. So we need it not to be this. So it's an error, it should be wider and we are not allowed to have these swings because then it's a playground and then it's very difficult to get permission to make it so something like that. And we needed to be like an open house. It's not possible that it's a close one, but then it's still, in a way we're thinking and hopefully more wild or. Yeah. And then and then we hope that citizens and protect will make a more Yeah. Like this Plante's boxes and and so on. And so, so, so it's still what we hope, but then it's just more weird and so on because otherwise it will just be like a small playground house and the, and it's important that it's have more a structure of a sculpture. But, but that's, but this is what we're working with right now. Cool.

Lazaara: Yeah. Very nice. And and have they kind of discussed or anything about that this is just kind of purely out of curiosity, but the road that's there?

Emilie: Yeah, we talked about it because we need it for us. It could be nice that the fins are just. But it's called, yeah, make an area around the green spot, but right now, actually, we went there for some weeks ago and I think something called team if which are their technique and environment department. And we think it's them. It made all these plant boxes actually around it. So we need to figure out if it's for just for now or. Yeah, because before there was a holding there. So we think it's for them to do it. Yeah, but but it's important that that you can have your children run there and not be afraid of there's car. Yeah. And so on. So we hope it will be closed but we don't know and we don't know if the recycling station. I think that's a good idea. OK. OK. And we still, we still don't have the permission to build it there. But but that's what we're working on now. And we, we really hope the, the recycling station, I think it's a good idea. But right now they need to

21 | Meeting with Emilie



Team IILLAA
Author Lamiita Traista
Theme Empirical investigations
Date 13.04.21
Appendix 21
Page 4 of 4

ask everyone, all the leaders and so on. And then later today, I need to call the people from a technical and environment department to ask the permission. And how long will it take to get the permission? Because sometimes it takes six months, sometimes it takes three weeks. And yeah. And so so we don't know. And it's a yes, but we hope because it's it's not the what is called it's not it's not a wild ground or something like that. So yeah. So we hope it will be fine.

Emilie: Yeah. It's not protected or anything. Yeah. Protected. Yeah. OK, it's nice. Very cool. And it's still either August or September that it's going to be built hopefully.

Emilie: Yeah. It's, it really needs to be that because the money we got for the project was from nineteen so we really need them to have it now. OK, and that this, this open festival is the tenth its growth timber and we really want this culture and the network to be a thing there. And we'll have a plan and hope that that for the festival we can show a lot of green projects and workshops and culture that we can hopefully at that place. But but also just around the pool. And you if you want to be a part of it. Yeah. Just let me know and. Yeah, I know. When you are done, a project is everything, and when you're finished, you want to do something else. But I talked about you for my bosses and they just like, oh, so exciting. And yet you say they want to do more stuff and so on. So you think it's really interesting. Just always let me know and figure out if you want to explore something or do something.

Lazaara: Very cool. Thank you. Yeah. Thank you. Yeah. And this is I don't know, at least for me this is the most fun and one the project I've thought about or like you think about in my free time, the most willingly. So yeah. Yeah. Very, very cool.

Emilie: And one of my bosses asked, what do you study? And I always like to remember the name, but what is it?

Lamiita: Again, it's sustainable. Design, engineering,

Emilie: OK, engineering. But then a lot of my colleagues are asking if you are a scientist, but is it.

Lazaara: We don't really know what we is.

Lamiita: I think it's a combination of everything, so that's why it's like design and engineering and sustainability.

Isabella: I think the thing that we are the most, though, is designers. Yeah, I think because for engineering, I don't know. We've never had to do math, so. No, I mean, that's not engineering. I don't know. Yeah, it's always been our bachelor, you know, during this course. No. And also to remember that it's super new. So it's I think it started in 2015 or a little bit earlier. So we're kind of creating the master together with the university. So we always give feedback every every six months or whatever. Yeah, because they need it. We need it, of course.

Emilie: OK, so cool. But it will give a lot of sense, especially in these times. OK, cool. It's good because I said the same thing but I was like oh I think it's more like the signing but also about this nature.

Lazaara: It has the flexibility within it to kind of choose your way because I think sustainability in general touches all aspects of life. Yeah. So it kind of depends on, I guess, the person and then the project who you're working with in this kind of thing. Yeah, but yeah, that's why I also like in in this semester just to close up. We are we we, we have different backgrounds like. Yeah. Really it's super great in a good way. That's the thing. Because then in reality this is what will happen if there was a design idea or whatever.

Emilie: Yeah, that's what I started at the university who are really similar to Aalborg. And it's just it's just so nice when you're finished because actually you understand the reality. You understand how things are working. Of course it's new and so on. But but it just used to work in this project kind of mind you you you used to work with different people and you used to. Yeah. It's just I can really recommend it to study in this way and yet come out into reality and and can you. Yeah.

Emilie: OK. And not be too scared of it because you're kind of scared for it in some way.

Emilie: OK, yeah. And you used to go out to reality and, and ask for things and to find the result and so on and. Yeah. And the other university it's more like just be in the books and find the answer there. And that's also a nice way. But I really like this. It will work you know.

Lazaara: Oh man. Yeah. But now we're thinking about, you know, like after you graduate what you did is so that's always an added stress. You know, you leave the comfort of of the walls of university that you in some way.

Emilie: Yeah. But that's all. But first you just relax and enjoy not having this tension. This is always the part what is called the somebody who what is, um, you know, when you say, OK, I'm willing to study, but I also want to just take a nap or something like that so you can always study when you are a student. And it's so nice to say, OK, good bye for love

Lazaara: and say hello to a new world.

Emilie: Looks cool, but it is. Yeah, but I think when you figure out the date we went to the workshop, should it be a weekday or weekend, they.

Emilie: I think if we won, I mean, depends on what people we if we have already a group of people from Facebook or whatever, then I guess we do. But if it's random people, then we can. So people are free.

Emilie: Yeah, yeah, yeah, yeah. Another thing is, I mean, kind of obvious, but just for it to be good weather. So maybe. Yeah. But you can

[..]

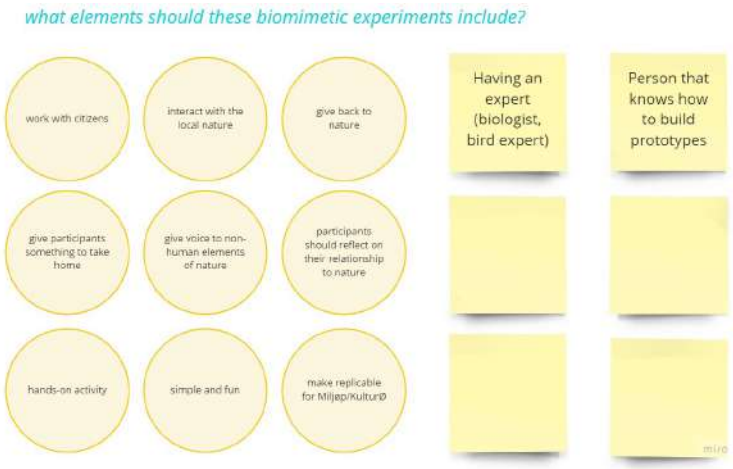
Isabella: Yes. Yes, yes. So yeah we'll make up like a list of criteria practically and then share it with you so that we can be aligned. Perfect. OK, yeah. I'll talk to you soon. Yes definitely. Thank you so much. Thank you, Emilie!

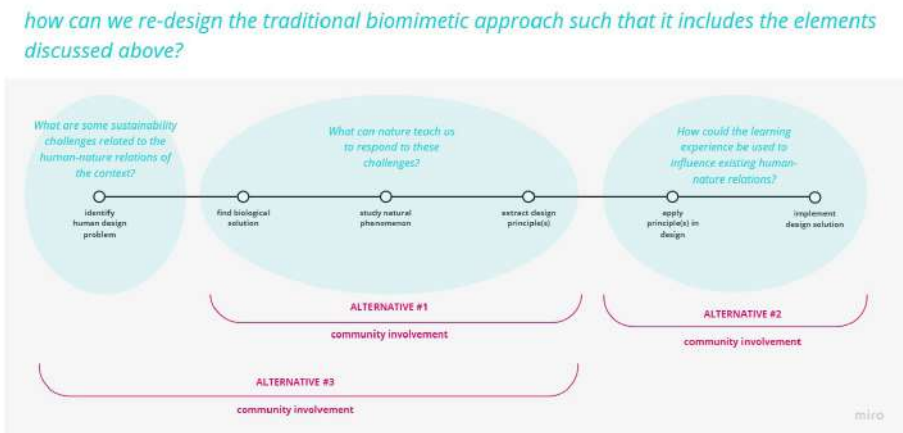
22 | Meeting with Signe, Louise and Emilie

Team IILLAA
Author Lamiita Traista
Theme Empirical investigations
Date 12.04.21
Appendix 22

The insights are from a meeting conducted on 12.04.21 with Signe Dragenberg, park manager at Københavns Kommune, Louise Purup Nøhr, project manager in Miljøpunkt Østerbro, as well as Emilie Bernt Haag, culture and project coordinator at Kultur Ø.

Presentation of alternatives of the biomimetic process for the workshop on Miro Board





Emilie: I can start to say that I think it's so interesting and and every time we have a meeting, I really learned something new. So it's really nice for me. It could be involving people in some of the cities and in so many different ways. But it's really nice that Signe is in this meeting because I think she knows more what is possible at Kildevældsparken and what are we allowed to do. And I think I think that's have a lot of. Yeah, a lot to say. So for me at the cultural part and creating this green network with the with Louise, it could be whatever whatever we are allowed to. I would like to deal with the islands on the lake and so on, because I think it gives such a good picture on. I didn't knew that that was so important and for me it was just a lake. But when you say this, I'm like, OK, it gives. Yeah, it just gave a lot of sense. So for me, I think that would be a nice thing for the citizens to. Yeah. To be a part of. But but for me it's really what, what are we allowed to do and what does she think it's would be good for the park and so on.

Signe: Then I can say something about that. I also get quite fascinated about all this, you know, and I think also I'd kind of fall in love with the idea of this small floating island in the middle of the lake, because it's it's it's a new thing and it's isolated and it's you can actually build it. It's not just something theoretical or something that you get more information about, but you can actually end up with a product. And I think that's kind of important when you go with the with students and students and involvement that kind of keep them interested. And it makes sense to have a critical goal. And afterwards you can go and say, hey, we made that one. So when when the students come and they produce X, then you can say I'm part of this. So you can kind of see actually something coming out of it. So I think that is a very good idea. And also I think it would be good to ensure that it is an isolated project rather than something that interferes with the maintenance of the park, because then it becomes more complicated. and what can we do and when do you do something and what do the garden looks like and don't? And that's all always quite complicated when we try those things also because our experience is that not the citizens of the volunteers or whatever, they they have a lot of ideas and a lot of visions that they want to do. But actually sometimes it kind of falls apart because it's sometimes a bit harder than they expected it to be. So often we we end up with having to. Take over those projects, so. Our gardens are not always that keen on those kind of projects, because the experience is that we end up with something . So I think that this one where it's it's. Very concrete and very isolated. I think that is a very great idea to bring. I think it's possible to do in terms of getting exceptions from border stuff and all that kind of commitments that are needed in order to, if we think about it, doing something about the water quality. And that is very complicated. So I wouldn't want to that.

Lazaara: Our biomimicry supervisor also suggested the first proposal as well, because sometimes trying to have people to think about what the problem is, is maybe a little bit difficult and to give them kind of an initial direction and then have them kind of enter the the creative space in that way. Great. And then this could possibly I mean, it would be nice to ultimately somehow connected maybe to the the future activities that will be happening in the art installation. And so this is just an idea, the kind of the top of my head. But just having these floating islands which need some kind of gardening work before or after, during maybe to kind of include the or maybe I don't know how aquatic plants grow, but maybe you could start the seed in the Kolonihavehus. I think that. Right. But the garden center, the house, the Dambo thing that will have to be there and maybe start growing them there, but then put them there or something just to kind of create a dialogue between the activities that are happening there and then the kind of required either maintenance or or renewal of these floating islands or something.

Louise: Can I ask a question about the floating islands? Because I'm not sure exactly what they are and there's something that citizens can make themself or how how do they work?

Lazaara: Yeah. Can we show the picture in the miro. Yeah, sorry you were not there when we showed them first time.

Lazaara: And just so they are, I think there are different ways of going about it. Yeah, so it's it would be kind of like growing, creating a planter that could be so it's the planter is I mean the materials can kind of vary. But the point is, I think for the roots to be able to penetrate through the ultimate container so that then and then in the container you have kind of layers of what we would study from the natural world and kind of imitated in this container and have the vegetation. And then these would be floating in the lake and the roots would be able to penetrate through the whatever material. In this case, it's a wire basket. It could also be kind of like a like a natural fire or something. Yeah. And so they would just be like this. Yeah

Louise: So as citizens, they could they could participate in creating the actual island. Yes. And then you can put it into the lake.

Lazaara: So so the. Exactly. So it could be kind of the in our activity timeline, the middle bubble would be with the citizens really studying how these plants work and what it means, how in nature are nutrient cycles in lakes by plants. And so we would really look into that and study it and then we could then take those lessons and then with the citizens be like, OK, so let's get our hands dirty and. Exactly. Do it together.

Lamiita: So it be both alternative one and two together.

Louise: Yes, it sounds really interesting, especially if it is that they end up having this actual product that will be put into the lake and that they helped create. Yeah, yeah, yeah.

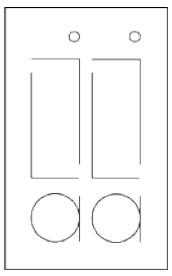
Emilie: It would be really nice. And I think, um, just before we go about the the art sculpture, uh, I actually have a meeting with the with Thomas today and it was still hopefully be built in August or September. And I think you should have this workshop before.

Emilie: But then but then we can we can figure out it. The citizens will love this idea and and how can this be it. Does the island just live for themself or do we do something with them for the winter and so on. And then we can take these workshops and that knowledge into the sculpture house and make workshops from there. So. Yeah, so. So totally. You can. You can. Yeah. I think thinking in that and you can come back and make the work.

Lamiita: Yes, totally agree. I mean also we were thinking about this staging of the workshop, kind of a rehearsal for the green activities that can be done in August when the art installation is done.

Emilie: Yeah, that would be so, so perfect. And it's just nice to start up in an environment and a community of of green thinking with this idea, because it really help us thinking, how can we think in green projects? I really like it. Yeah. And I have to go. I am really sorry about that. No, thank you. Yeah, but we can maybe talk later. I will want to know what you figure out and something like that.

22 | Meeting with Signe, Louise and Emilie



Isabella: Yes. Thank you. Bye bye.

Lazaara: OK, so then if we were to take a. Let's say we're trying to do alternatives one and two, how because you have experience with facilitating workshops and so on, how would you go about maybe. Yeah, like the kind of practical steps that we might have to take to to get it going.

Lamiita: So, for instance, maybe you have some criteria or elements that you think would be really important to to focus on besides on this one.

Louise: And I think it's difficult right off the top of my head, especially because it's still kind of fluffy. I mean, is one workshop is a series of workshops. And who are the I mean, I think sometimes when we have citizens on like guided tours in nature areas and stuff, we usually have like an expert, a someone who knows the local nature, who knows. And like we've had these I don't know what Sankar is called in an English way. You eat like forage? foraging?. You eat. Yeah. We will have an expert in local plans and or this one grows here and this is called that. And you can eat that or whatever you can do with it. And that's something that people I think they really enjoy getting that knowledge, especially when it's so local, is like this grows right here in your local park. And that expert can be anyone. Really. Yeah.

Lamiita: And it's really good. We were also thinking that it's important. So, for example, a biologist, if it is to really dig into the natural phenomena and I don't know if you have any, like, contacts for other biologists who just have a dialogue with someone from Copenhagen University. That's so that could maybe get involved.

Louise: Yeah, yeah. I think we used to. They're not biologists. More like a gardener. Gardeners. OK, OK. Maybe Cedeño someone's in the store, but otherwise. Yeah it depends because if it's, if it's on, especially on the lake and, and these islands I mean then I guess it's some very specific knowledge that I needed and that's why I'm still not sure. I mean because if it's broader, just about Nature and Kildevældsparken, it might be another kind of expert.

Signe: And if you if you are thinking about the of something you need. Someone wrote about how to build them and so that they will actually remain. Yeah, yeah. Because actually years because someone tried to build a big island in the lake and actually sank, so.

Signe: And also, if if the aim is to build it also with the concept of being a nesting area first, then you need someone who knows about birds. Yeah. But to be found in order to to want to live there. I was so focused on that because I was the worst it could be also perhaps a more a more simple project about that actually works in in in the park, a different kind of work that you could be building those boxes and perhaps with the kids or something to teach them about different kind of birds and different kind of houses. And we should be outsourced or whatever. And in order to to to attract different kinds of foods, it would be something for those who need it.

Louise: if if you're looking for more sympathetic than these oh also always popular. And if you can make it, I mean it could be similar to the birds.

Signe: The problem with the piece is that. And so I would call it the municipality is quite strict about certain rules, about how close it should be, a bit isolated and some issues about that, it's a bit more complicated than the birds. But it brings something to natural areas. But it's it's a lot of times we have to say no.

Signe: Actually, there's also quite important and actually more important than we are as people aware. So it would be a very great theme to pick up, but I'm not sure that we can find a solution that will fit into the park, OK?

Lazaara: Yeah, I mean, I guess for practical purposes, we have to hand in our thesis the 4th of June, so we would ideally like to stage this activity like the end of this month or beginning of next month so that we have time to then kind of analyze it and then learn from it. What could be changed? What. What it kind of requires, what was missing, what was too much of this kind of thing, so yeah, so we're thinking also maybe too, in order to kind of get people interested or to kind of get people involved to use maybe the Facebook group. We so that you added you add this to so that there's hopefully already people that are kind of interested in green activities and then, yeah, if you would you have any recommendation on how to or even if you have like the context of citizens who, you know, would maybe be interested or anything to help us kind of collect a bit of a group for it?

Signe: Yeah, I think that. If if you want to make something about islands and the water, then there could be an issue about whether you have time enough to get the permission from the from the Border and Environmental Department of Quality, I'm not quite sure whether it would create any, but it's just the fact that if you if you build it with organic material that can get out into the lake, it could be an issue. I'm not I don't know whether it is working. And that could be something. Perhaps it's not. So I think that is something that we need to find out quite fast, actually and then and then I know a citizen that lives just a few streets away from the park. He has actually got permission from us to put up bird houses. And he's got those, And sometimes he writes me and tells me what kind of birds he sees down there. And I'm quite sure he would be very interested in doing something about it. But it would seem I think he does it with his son. I'm not quite sure what sort of grown man or what, but but I think they would be interested, I think. What's your take on this as to how would you pick the people to participate? Is it just anyone or is it about children or young people or older people.

Lamiita: I think that the more diverse the better, because in reality, when the solution is going to be, it's going to be open for everyone. So it has to accommodate all kind of green activities. So we would like to test how is that going to process would go with everybody that's interested?

Isabella: Yeah, yeah. At least then we can figure it out. Maybe only children are needed like this. This activity will be an experiment, kind of so we can test it like for real. OK, maybe only adults because children, I don't know, make a mess or whatever the other way around.

Signe: So yeah, stuff about birds is that they're cute and they attract children and hold onto their attention, but also some grandparents and stuff. Yeah. Not to have birds or animals as some part of the thing would be, I think, a good thing.

Isabella: OK. OK, yeah, you know, I don't know, I have, like a question, but I don't know if it's a stupid one. Signe you were saying that we have to ask permission from the borders, but who should we contact or I don't know, is there a specific website or. I don't know

Signe: I just tried to find out who it is. So I would be my letters to to whoever it is that that you need to contact because I know myself. So I'll check it out and I will send you an email.

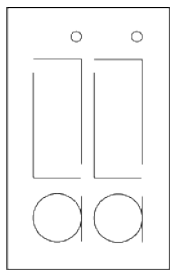
Isabella: OK, thank you.

Signe: That's quite essential that you're running out of time due to the fact that you're waiting for some permission. Yes, thank you. Anyway, when you do the activity of the workshop, if you do it in the park and you need to have the permission to do that kind of arrangement, but that's kind of standard procedure that is on my side.

Louise: I'm just thinking, if you if you are under time pressure, then because you say it is supposed to be an experiment. So maybe you can also make like a pilot workshop so where you don't make 20 islands and then put them in the lake. But, you know, you just kind of make it just try with one or two and then maybe you can make it. Maybe that's already your plan

Lamiita: instead of focusing more on the island, we will focus more on the process. Yeah. Or how big it's going to be. It's just to experiment, to see how people react, how how can they get involved.

22 | Meeting with Signe, Louise and Emilie



Team IILLAA
Author Lamiita Traista
Theme Empirical investigations
Date 12.04.21
Appendix 22
Page 3 of 3

Lazaara: and we're always taught as designers to failing is kind of a good thing, right, to fail as fast as possible or. Yeah. And just learn from from the failures. So we have a lot of conceptual frameworks to analyze failures as well. So we're also open to. But yeah. Yeah. We're trying to keep our ambition levels as realistic as possible.

Louise: Yes. We can also help, you know, when when you need some participants for they actually workshop, we can share in our newsletter and Facebook and Instagram and make people come that way. Maybe.

Lazaara: So maybe our next step is to. The kind of practical permission things and then creating like a. Amputation, like an advertisement, yeah, like an invitation for the workshop so that it could then be spread through our networks and then we hook people like fish and join us. Great. OK.

Signe: And one of the economical means to do this. I mean, if you're building an island, how do you get the money for it?

Lazaara: Well, an island probably will just cover themselves to get the materials for just a prototype and then have people grow their plants or something from seed. So, yeah, for just the sake of an experiment, I think we're just going to cover it or talk with the school about it.

Signe: Yeah, but then at the local udvalg, you know, the local what you call it the. They sometimes have these. Funding said you can apply for and I think that the I know someone has just applied for doing something in the water, something, but so it could be a possibility that money from them to do some.

Louise: Yes, there is also a biodiversity fund, but the deadline is already the 18th of April, so it has to be really quick.

Lamiita: Oh, OK. OK, maybe we should consider it.

Signe: That's the one I send you this contact - Magnus. OK, so by the 18th of April.

Isabella: OK, great.

Signe: All right. But I think if you're sure about the time stuff and I think one with the birds and the and the and the bird house, this is the most realistic with the municipality. Yeah. Yeah. You just need an OK for me and all the other departments and stuff. So simple. OK.

Isabella: Yeah

Signe: I would just find out who you should try to contact about the permission, I think it would be useful to you if you know exactly whether there will be some contact between the organic material, whether it will be disrupting out. I think so. If they want to know the name of the island that was before was just made out of wood, was a plane platform. So that was not an organic.

Isabella: OK, yeah, I think we will deliver like a list of exactly what is needed, so at least we are super transparent and we figure out that. Okeydokey. Yeah. You think, yeah, we're good for now.

Isabella: Yeah, OK, thank you very much for taking the time to meet with us and listening to us and getting some input.

Lazaara: Yeah, and I think now we have a pretty much clearer idea of what we're going to do next and the rate at which we have to do it, which is always good. Yeah. So thank you very much!

23 | Floating islands inspired from wetlands

Team IILLAA
Author Lamiita Traista
Theme Research
Date 05.05.21
Appendix 23
Page 1 of 6

This WS is exploring wetlands as biological models for building biomimetic floating islands, as well as previous attempts from literature, as well as in practice, to use wetlands as inspiration.
In the first part, the definition, types and elements of natural wetlands will be explored.

What are wetlands?

Wetlands are not easy to define as they encompass both water and land environments at the same time or better said, most of the time, since some wetlands can be seasonally aquatic or terrestrial. [1]
In general terms, wetlands are areas where water is either near the surface of the land or shallow water covers the land, thus the water being the main factor controlling the environment and the associated habitats. [1]

A definition of wetlands which is most widely accepted, including by the European Commission, has been signed in 1971 in Ramsar, Iran as part of the Convention on Wetlands, meant to be the first step internationally to protect these ecosystems:
"Areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres" [1, p. 3]

Picture 1: Dousbad Mose - wetland in Dyrehaven, Klampenborg
Photo: Søren Rud [11]

The importance of wetlands

Wetlands are among the most threatened ecosystems due to "[..] drainage for agriculture, infrastructure developments, forestation and malaria control, blocking and extraction of the water inflow, over-exploitation of groundwater resources, or the building of dams, to mention but a few of the many reasons why wetlands are deteriorating." [1, p. 4]

Protecting wetlands is crucial, because they are some of the most productive ecosystems on Earth in sustaining biodiversity. This is because they support plant and animal species during key stages of their lifecycle and help with cleaning and recycling water. [1]

Wetland ecosystems provide the perfect conditions for a vast diversity of fauna species, such as birds, dragonflies and amphibians, as they prove to be vital for nesting, but also flora species, since many specialist plants depend on wetlands. [1]

Plants present in wetlands

The aquatic plants which are growing in or near water, thus present in wetlands, are known collectively as macrophytes. This distinction is made in order to differentiate them from microscopic algae and other microphytes. [2]

Aquatic plants have diversified forms and can be classified in five major groups [2] (see figure 1):

- **rooted emergent plants**: rooted in submerged soils or in aerial soils at about 0.5 m above the water table
- **rooted submerged plants**: rooted in bottom sediments with leaves under water
- **rooted floating-leaved plants**: rooted in bottom sediments with floating leaves (water depths from 0.5 to 3 m)
- **free-floating emergent plants:** live unattached in water
- **free-floating submerged plants**: submerged, nonrooted aquatic plants

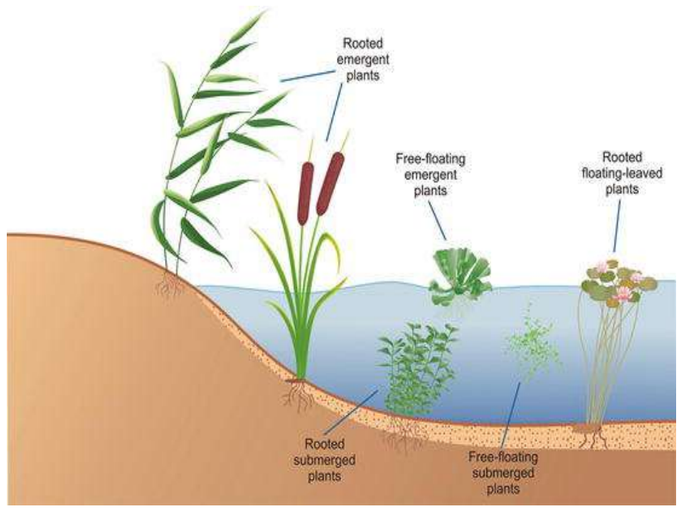


Figure 1: Five major groups of aquatic plants (macrophyte) types [2]

Natural floating wetlands

Wetlands that most people are familiar with are constituted by plants rooted in the bottom sediments, along with free-floating plants, but there are also natural floating wetlands which occur when there is "[..] a combination of reed rhizomes, other organic material and soil which breaks away from river banks and lake bottoms" [3].

These gain their self-buoyancy through the air retained in the spongy roots and rhizomes, but also due to anaerobic decompositions in the sediment, where "[..] CH4 gas is generated in the bottom and gets trapped in the root mat, which keeps the macrophyte in floating form on the surface of water" [4, p. 4].

These floating ecosystems' existence depend on a sequence of natural conditions of the water where they form, such as low depth, high mineral content, low oxygen content to slow decomposition of dead plants, etc. [5] (see example of natural floating wetland in picture 2)

Picture 2: Natural floating wetland in the Danube Delta
Photo: Staffan Widstrand [12]

23 | Floating islands inspired from wetlands

Team IILLAA
Author Lamiita Traista
Theme Research
Date 05.05.21
Appendix 23
Page 2 of 6

This section will infrom about artificial wetlands, known as Constructed Wetlands (CW) and a variant inspired by floating wetlands, thus known as Constructed Floating Wetlands (CFW).
Some of the particularities of both CWs and CFWs will be described, as well as the purpose of using a biomimetic approach in building a CFW together with an example of biomimetic CFW.

What are Constructed Wetlands (CW)?

Constructed Wetlands (CW) are systems inspired by natural wetlands that utilize different plant species and bed materials, engineered so that the pollutants from water are being removed through an advanced natural process as it passes slowly through "shallow areas of dense aquatic vegetation, and permeable bottom soils" [8, p. 26].

CWs have been researched extensively for their potential of reducing aquatic pollutants and nutrients in industrial effluents, sewage and polluted water [4, p. 2].
An example of a CW setup for waste water treatment can be seen in figure 2 below.

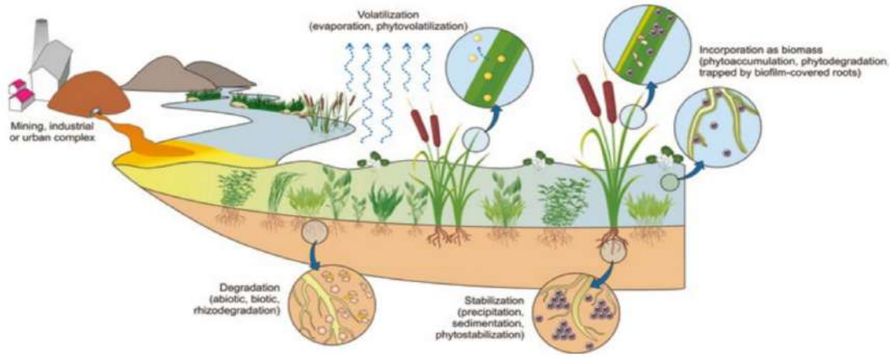


Figure 2: Exmple of CW setup for waste water treatment [2]

What are Constructed Floating Wetlands (CFW)?

Constructed Floating Wetlands (CFW) are variants of Constructed Wetlands and have been researched under different terms, such as 'planted floating system beds', 'artificial or vegetated floating islands' or 'ecological floating beds' [13].

Unlike the traditional CWs where most of the roots of the plants get attached to the bottom soil of the pond, CFWs have the roots of the plants in direct contact with surface water which leads to more nutrient uptake from the water. [8] (see figure 3)

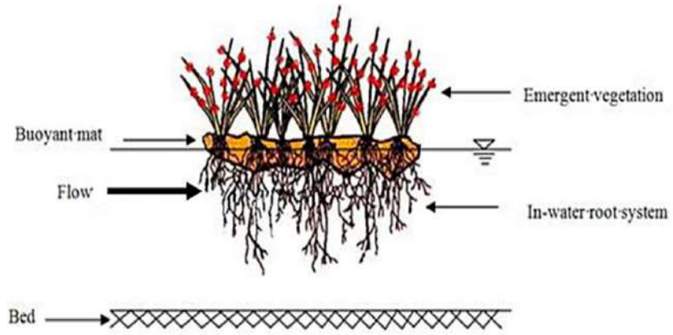


Figure 3: Schematic vertical section of CFWs [13]

CFWs are still a major challenge to design in a way that resemble natural floating wetlands due to biomass production and decomposition that needs to be synchronized with the colonization of peat-forming species within a reasonable time frame. [5]

A schematic vertical section of CFWs can be seen in figure 3.

Where does biomimicry come in?

Biomimicry can be used in different ways to achieve enhanced functionalities for the CFWs. In this case, the type of biomimicry being referred to is ecosystem biomimicry since the wetlands used as biological model for the biomimetic process are ecosystems. So far, the focus has been mainly to enhance CFWs ability of removing pollutants, especially nutrients, from the water. [4]

An example of CFW created using a biomimetic approach is the BioHaven® Floating Islands [6].
Concerned about the damage caused to wetlands and waterways by the excess of nutrients from agricultural runoff, Bruce Kania came up with the idea of replicating the floating peat bogs that he encountered as a fishing guide in northern Wisconsin [7]. He then brought together a team of scientists, engineers, horticulturalists, and botanists who, through biomimicry, came up with the floating islands concept which turned out to be much more efficient for nutrient removal than the traditional constructed wetlands [7]. The invention is now widely distributed by Floating Island International since 2005 [7].

In contrast to the traditional CFWs, in the BioHaven® Floating Islands, the roots of the plants together with microbes grow in and within the floating platforms, after which the roots extend into the water, which gives more surface area for larger bacteria population and thus, more nutrient uptake. [8] The floating platforms act as a perfect medium for structured microbial activities, which are also called biofilms, making the removal of nutrients more efficient. [8]

The materials used for the floating platforms are artificial light weight bio-carriers made out of recycled plastic bottles which form a matrix that allows water to pass through, but also allows plants and biofilms to grow - the same way that natural wetlands function. [7]

Accommodating these important elements which are vital to a wetland's ecosystem, leads to attracting also other species such as fish, birds and as well as other microorganisms. [10]

At the same time, the BioHaven® Floating Islands can be placed in water of any depth or shape and can support either terrestrial or aquatic plants. [8]

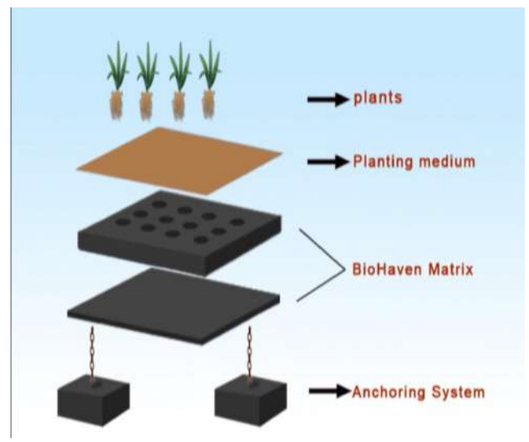
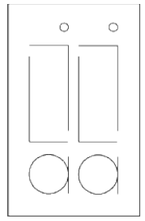


Figure 4: Components of the BioHaven® Floating Islands [10]

23 | Floating islands inspired from wetlands



Team IILLAA
Author Lamiita Traista
Theme Research
Date 05.05.21
Appendix 23
Page 3 of 6

As most of CFWs have as their main function the removal of pollutants from the water, this section will explore other functions that natural wetlands perform as complex ecosystems, which can be used in the biomimetic process.

How do wetlands function?

Dama-Fakir et al. (2018) argues that the overall design and performance of the CFWs depends on a deep biomimetic process where the natural wetland system, functions, critical components and interdependence of the various components should be explored by interdisciplinary experienced teams. [9]
Some of the key functions of wetlands have been abstracted by Dama-Fakir et al. (2018) in the context of a project in South Africa (see table below), which can be used to inform the design process for CFWs, although a localized assessment of the context should be performed.

What are biofilms and what is their role?

In some of the microfunctions mentioned in the table below, microorganisms such as bacteria are being mentioned as part of the process. These microorganisms form communities by attaching to each other and stable surfaces, which lead to the formation of biofilm. [4]
Biofilms are slimy and sticky in nature and consist of cells and extra cellular matrix produced by cells. This makes them able to entrap suspended solids from water, but they also "[..] provide mechanical stability, enhance water retention, improve nutrient absorption, give protection against viruses and possess antimicrobial activity." [4, p.2]

Function	Key role player	Microfunction	Description of Interdependencies which maintain ecosystem balance
Flood Attenuation	Hydrological zonation – wetland vegetation	Plants exist within and are adapted to various 'hydrological zones' according to the amount of water they receive. Each type of plant provides specific energy dissipation and flood resistance.	Plant plasticity enables survival during times of excessive inundation or complete lack of water, inundation allows plants to deposit seed beds up and down bank, ensuring survival.
Sediment trapping	Root systems of wetland plants	Hydrophytes such as Phragmites, act as mechanical filters for silt and clay particles in water. Hyacinths, Water Lettuce, Water ferns, etc. also provide good mechanical filtering. Phragmites and other macrophytes like Papyrus for effective sediment filters and will effectively immobilise larger sand particles as well.	Water inflow containing sediment is trapped by vegetation which in turn takes up nutrients from sediment and creates habitat for macro-invertebrates, fish and birds
Phosphate assimilation		P is rapidly recycled and reused by bacteria and small phytoplankton and over longer periods by zooplankton in open water (Moss B. , 2009) . P can also be mobilised from the sediments of some wetlands. Microorganisms such as Daphnia feed off algae that thrive on excessive phosphates which result from excessive organic runoff.	Birds such as flamingo's (Phoenicopterus sp.) are attracted to and feed on excess organisms which have multiplied for various reasons. Thus parameters are controlled within a narrow range around a certain optimal level. Phosphate is essential for most megafauna and the filter feeders are able to concentrate the resource.
Nitrate assimilation	Atmospheric nitrogen fixation by diazotrophs (input) and further nitrification is offset by losses due to microbial N mineralization to gaseous forms (dinotrogen, nitrous oxide) via denitrification	High productivity of wetland plants allows for uptake and removal of nitrates from the water. Nitrogen compounds are reduced to nitrogen gas which is released into the atmosphere.	Plants are grazed/browsed by animals, thereby removing the nutrients and allowing them to be redistributed
Toxicant assimilation	Fauna and flora	Bioaccumulation of toxicants by species of flora and fauna within the wetland.	Elements which are toxic to some organisms, are often not toxic for others and are thus hyeraccumulation of the toxins occurs within these species. Copper, for example is toxic to numerous plants at high concentrations while being an essential trace element (at low densities) to fauna species which eat these plants.
Erosion control	Stoloniferous vegetation root networks	Wetland vegetation roots hold substrate and prevent loose substrate from being carried away in water	Sediment and soils are bound by strong root systems that penetrate them and bind them. This retains habitat for other flora, micro-organisms and avifauna.
Carbon storage	Flora and microbes.	Water cover, plants and microorganisms	Anaerobic conditions created through water cover, as well as high productivity of plants due to environmental conditions result in plant production which usually exceeds decomposition in wetlands and results in the net accumulation of organic matter and carbon

23 | Floating islands inspired from wetlands

Team IILLAA
Author Lamiita Traista
Theme Research
Date 05.05.21
Appendix 23
Page 4 of 6

This page presents some of the general design principles for constructing CFWs, which have been found through literature, that can inform the creation of biomimetic CFWs (i.e. floating islands).

Designing CFWs

There are various factors that need to be considered when designing CFWs to meet certain functions performed by natural wetlands. Exploring them can inform general design principles for creating biomimetic CFWs.

Through a review of various case studies of CFWs, Samal et al. (2019) synthesized some of the main factors which can be discussed to inform the design of effective CFWs, with the main function being improving the water quality (see table on the right side). An illustration of general design principles can be seen in figure 5.

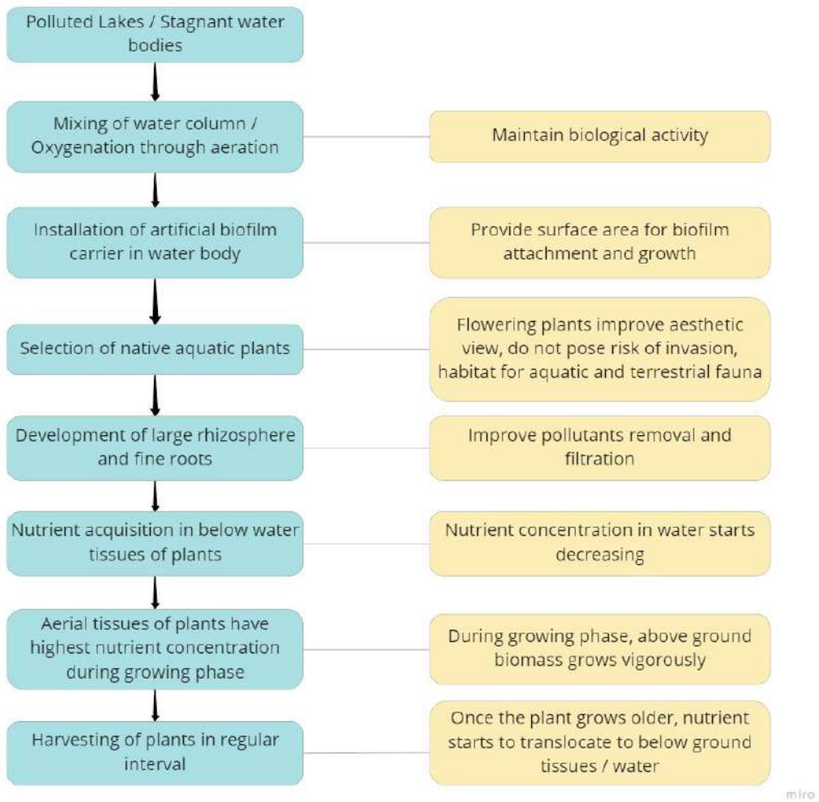
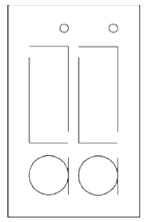


Figure 5: General Design Principles for CFWs - illustration adapted from Samal et al. [4]

Design Principle	Description
Screen suitable plants	- species must be able to float on water surface (high quantity of aerenchyma tissues) - species should be native, aesthetically pleasant, non-invasive and perennial species that can sustain the aquatic environment - species should have a high amount of nutrient uptake to act as insulation layer during winter - species can be aquatic, but also terrestrial, as they grow faster and have higher biomass - species should be chosen according to the water depth that they are being exposed to on the floating bed
Accommodate Biofilm formation	- biofilm biomass increases when increasing the underwater surface area - biofilms generated in biological surfaces have a higher diversity of microorganisms than in artificial biofilm carriers
Add growth media for plants and microorganisms	- porosity: it should contain enough pore space to allow exchange of air that maintain the aerobic condition - water retention: it should not absorb too much water as it can affect the buoyancy - impact on fertility: it should be able to sustain vegetation growth and microbial diversity - impact on water body: the material used should not affect the pH of the water - biodegradability: examples of biodegradable CFW growth media - Coarse peat-moss or coconut fiber adjusted with small amount of compost, soil, bamboo, charcoal, etc.
Ensure buoyant material for the floating bed	- the material should be hydrophobic (water repellent) so that it enhances bacterial adhesion process - the material could either be temporary, until a natural floating bed of organic material is established, or permanent (e.g. BioHaven® Floating Islands, where the aim was to have a material "highly porous, permeable, and resistant to environmental degradation" [8, p. 27]) - the materials used the most to achieve flotation are: sealed PVC or PP pipes, polystyrene sheets, bamboo interwoven with mats of natural fiber (degrades after several years), inflatable vinyl pillows, recycled PET, iron and timber supported by sealed plastic float tanks or styrofoam, thick coconut fiber mats supported by polyethylene nets and polystyrene foam etc.
Check vegetation coverage ratio and shading	- high vegetation cover (more than 50%): may prevent the diffusion of oxygen released from the air to water due to wind activity and reduce water treatment efficiency - low vegetation cover (9-18%) may have an insignificant effect on water treatment - shading: photosynthetic algal species start to decline when the sub light cannot pass through the water due to vegetation on the water body
Assess pollutants removal process depending on temperature	- low temperature restrains microbial activities and reduces their growth resulting in low purification efficiency. - total nitrogen (TN) removal: the rate of the microbial processes responsible for nitrogen removal increase considerably with each 10 °C rise in temperature from 0 to 30 °C (e.g. a floating bed treatment process in Finland reported only 14% total nitrogen removal) - total suspended solids (TSS) and total phosphorus (TP) removal, and ability to break down organic material: unaffected by cold conditions; depend on the type of vegetation
Maintenance	- partial plant harvesting: highly recommended to harvest plants in regular intervals above water portion, before they start to decay (otherwise, nutrients stored in the aerial parts of the plant go back in the water) - whole pant harvesting: researchers reported that a significant amount of nutrients are stored in the root system, although more research is needed to conclude on the benefits of whole plant harvesting - harvesting season: preferably around September - during summer, the above water biomass contains the highest concentration of nutrients, after which around September nutrients start to translocate to below water biomass

23 | Floating islands inspired from wetlands



Team IILLAA
Author Lamiita Traista
Theme Research
Date 05.05.21
Appendix 23
Page 5 of 6

Here are some of the considerations for building biomimetic floating islands, received through a meeting on 05.05.21 with Richard Haine, Director of FROG Environmental Ltd, a provider of the BioHaven® Floating Islands from the UK.

Considerations for building biomimetic floating islands

[notes after presenting the local context (Kildevældsparken) and our initial prototype]

• Key point - ther has to be a matrix where the plant roots grow that protects and support the root over time

• Be mindful of the coconut mat - needs to be thicker - improve the buoyancy and space for root to grow

    • Longevity of the substrate - to consider (i.e. more bamboo leafs - n.b. water log)
    • Need to maintain a certain buoyancy over time, but also contact for the roots with the water
    • Soil helps to mitigate the issue of plants not bieng able to adapt in the new environment - acts as a starter growing medium for the plant.
    • Make sure the roots touch the water
    • The more the water flows through the roots the better (i.e. increasing contact time of water with roots)
    • If the ph of water different than what the plants expect it could be a problem, but the soil can act as a buffer, so it is good to have

• Monitoring of the progress - would be good to keep track to see what plants work

• Water quality

    • Baseline conditions - 3 years of monitoring of inflows, outflows etc.
    • Then do a project and measure the variables and impact of the project
    • Don't collect data just for the sake of collecting data

• Number of islands to consider

    • 20% of the surface area covered with islands (US opinion)
    • Richard does not agree - seen water area improve with less: "Think about the hydrology of that system [..] Water quality - biological effect, nutrients uptake" (there is a research published on this)
    • Kildevældsparken - closed system: high retention time of the water in there, so good for floating islands to take up nutrients

"It is very important to have these discussions with citizens and I think it is a very valuable project if you are going to show them how to make the floating islands themselves and the implications they have for the lake" - Richard

• Circulating water - the more water is moved around the more contact time for the roots, so it helps improve the condition of the lake - mixing and contact time are important

• Lake minimal inflow and outflow - high retention (is good) time of water. Idea: Moving the islands around by people?

• Reasonable depth of the lake so that's perfect

• Anchoring

    • Water level varies little - perfect
    • 2 anchoring points
    • Huge sail effect when plants grow big, so the wind will move it a lot
    • Rule of thumb - 200kg of weight per 10m2 of island

• Maintenance of plants

    • To consider for long term (scaled-up version) - Sail effect of island plants (growing up to a meter tall or more)
    • There are different schools of thoughts
    • Amount of nutrients being locked in the plant itself is pretty minimal compared with the microbial uptake . His opinion - not worth the effort of harvesting the plants In the data he has seen, nutrients are more in the biofilm (see more details in the next page)

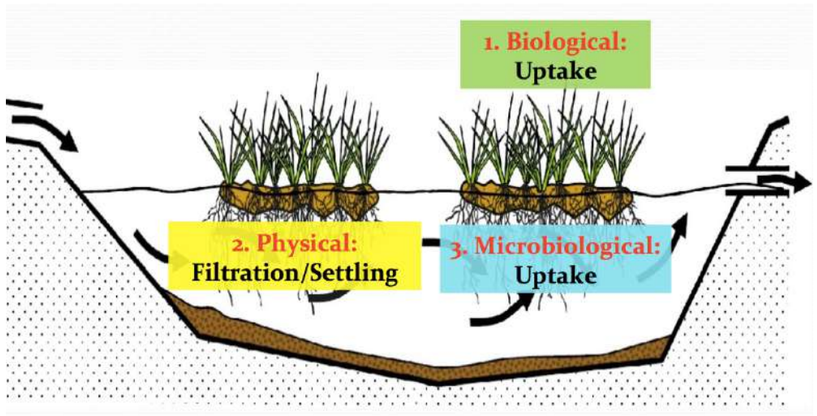
References
[1] European Commission. (2007). LIFE and Europe's wetlands : restoring a vital ecosystem. Luxembourg: Office for Official Publications of the European Communities.
[2] Favas, P. J., Pratas, J., Paul, M. S., Sarkar, S. K., & Prasad, M. N. V. (2016). Phytofiltration of metal (loid)-contaminated water: the potential of native aquatic plants. In Phytoremediation (pp. 305-343). Springer, Cham.
[3] Ingenieurbüro Blumberg. (n.d.). Floating Islands: Blumberg Engineers, Germany. Retrieved April 21, 2021, from www.blumberg-engineers.com website: https://www.blumberg-engineers.com/en/ecotechnologies/more-ecotechnologies/floating-islands
[4] Samal, K., Kar, S., & Trivedi, S. (2019). Ecological floating bed (EFB) for decontamination of polluted water bodies: Design, mechanism and performance. Journal of Environmental Management, 251, 109550. https://doi.org/10.1016/j.jenvman.2019.109550
[5] Overbeek, C. C., Harpenslager, S. F., van Zuidam, J. P., van Loon, E. E., Lamers, L. P., Soons, M. B., ... & van der Geest, H. G. (2020). Drivers of Vegetation Development, Biomass Production and the Initiation of Peat Formation in a Newly Constructed Wetland. Ecosystems, 23(5), 1019-1036.
[6] Biomimicry Institute. (2005). Versatile Water Treatment Garden Inspired by Wetlands — Innovation — AskNature. Retrieved April 24, 2021, from asknature.org website: https://asknature.org/innovation/versatile-water-treatment-garden-inspired-by-wetlands/
[7] Floating Islands West. (2020). Biomimetics Eco-technology Innovator Bruce Kania. Retrieved April 24, 2021, from Floating Islands West website: https://floatingislandswest.com/who-is-bruce-kania/
[8] Stewart, F. M., Muholland, T., Cunningham, A. B., Kania, B. G., & Osterlund, M. T. (2008). Floating islands as an alternative to constructed wetlands for treatment of excess nutrients from agricultural and municipal wastes–results of laboratory-scale tests. Land Contamination & Reclamation, 16(1), 25-33.
[9] Dama-Fakir, P., Dower, A., Janisch, C., O'Connor, C., Otto, D., & Welz, P. (2018). Biomimicry and Wetlands.
[10] Floating Islands West. (n.d.). BioHaven® Treatment Wetlands | Our Brand. Retrieved April 26, 2021, from Floating Islands West website: https://floatingislandswest.com/floating-islands-our-brand/
[11] Københavnergrøn. (n.d.). Dousbad Mose. Retrieved April 17, 2021, from KØBENHAVNERGRØN – 100 GRØNNE OPLEVELSER website: https://www.kobenhavnergron.dk/place/dousbad-mose/
[12] National Geographic Romania. (n.d.). Plaurul, insula de stuf plutitoare. Retrieved April 21, 2021, from Revista National Geographic Romania website: https://www.natgeo.ro/natura/delta-dunarii-perspective-noi-galerie-foto/attachment/plaurul-insula-de-stuf-plutitoare
[13] Pavlineri, N., Skoulikidis, N. T., & Tsihrintzis, V. A. (2017). Constructed floating wetlands: a review of research, design, operation and management aspects, and data meta-analysis. Chemical Engineering Journal, 308, 1120-1132.

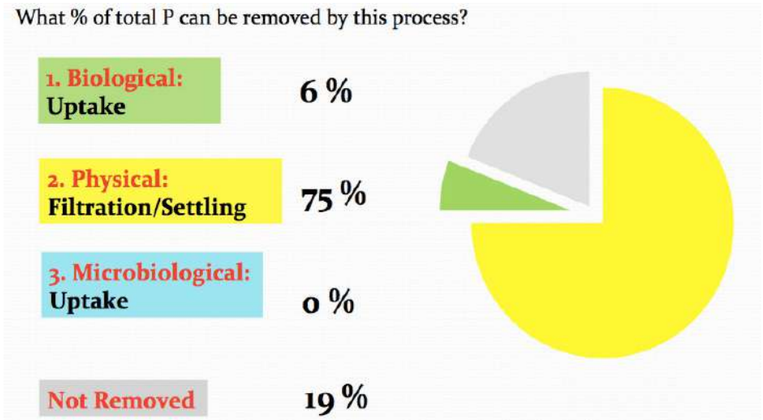
23 | Floating islands inspired from wetlands

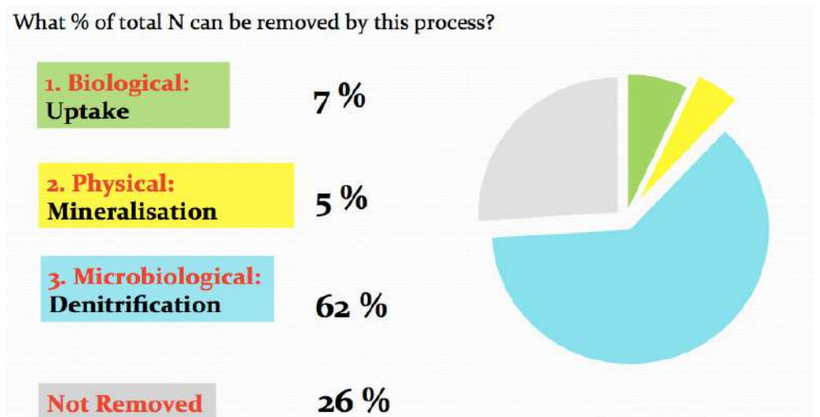
Team IILLAA
Author Lamiita Traista
Theme Research
Date 05.05.21
Appendix 23
Page 6 of 6

Data regarding nutrient uptake in biomimetic floating islands received through a meeting on 05.05.21 with Richard Haine, Director of FROG Environmental Ltd, a provider of the BioHaven® Floating Islands from the UK.

Nutrient (N and P) uptake in biomimetic floating islands - Data from FROG Environmental Ltd







Evidence & Peer Reviewed Data

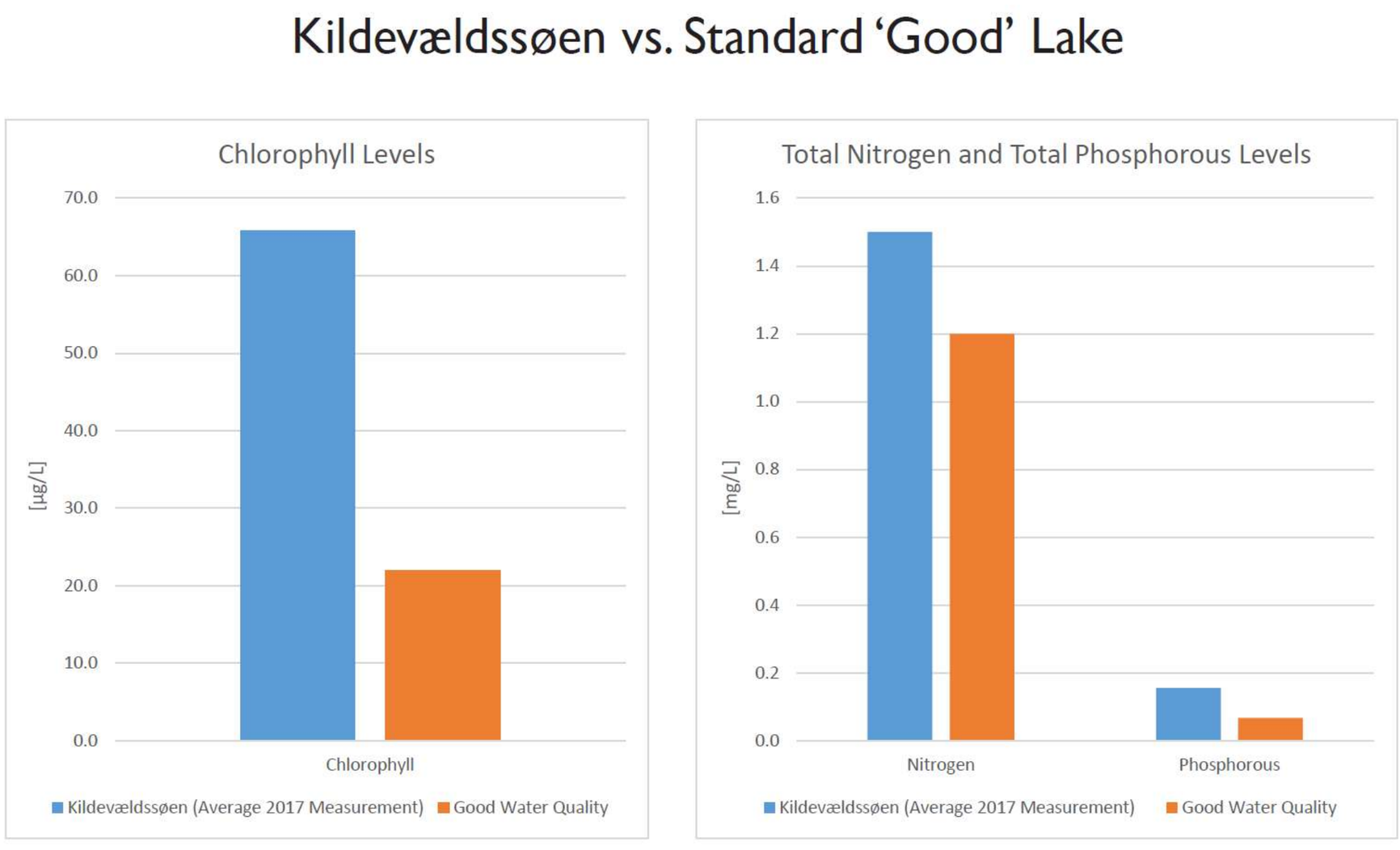
	Study	Moortel	White	Yang	Stewart*	Stewart*	Borne*	Tanner	Stefani	Winston	Winston	Chang	Chang	RANGE
	% cover	100	100	100	100	100	50	50	19	18	9	8.7	8.7	8.7-100
	notes	anaerobic	anaerobic	anaerobic	aerobic	anaerobic						storm	non-storm	
FTW	TP	12	59	6	91			58	65	88	37	14	47	**6-91**
	TN	11	67	31						88	48	16	16	**11-88**
	NH_4	-2		-28	66					98	55	-2	51	**-28-66**
	NO_3/NO_x	78		91		100				65	82	53	22	**22-100**
	Cu_{tot}	16					37	57						**16-57**
	Zn_{tot}	17					63	19						**17-63**
controls	TP	18			53			3		58	35	4	8	**3-58**
	TN	40								59	36	-26	-15	**-26-59**
	NH_4	33			26					50	8	-8	15	**-8-33**
	NO_3/NO_x	46				42				50	60	-183	12	**-183-60**
	Cu_{tot}	45					17	7						**7-45**
	Zn_{tot}	48					37	-1						**-1-48**
improvement	TP				38			55		30	2	10	39	**2-55**
	TN									29	12	42	31	**12-42**
	NH_4	*study*			40					48	47	6	36	**6-48**
	NO_3/NO_x	*excluded*				58				15	22	236	10	**10-236**
	Cu_{tot}						20	50						**20-50**
	Zn_{tot}						26	20						**20-26**

Notes:
(*) indicates data extracted from graphs.
In Stewart study, PO_4^{3-} was assessed instead of P

24 | Level of nutrients in Kildevældssøen

Team IILLAA
Author Isabella Ursano
Theme Research
Date 01.06.21
Appendix 24
Page 1 of 1

Since Kildevældssøen has a poor biological value, characterized by poor water quality, low biodiversity, and high level of nutrients - as identified by the park's development plans -, we researched on different elements that constitute the lake's quality. The graph below depicts the comparison between Kildevældssøen and a standard 'good' lake. We presented this information during the workshop to explain the discrepancy of chlorophyll levels on one side, and the total of nitrogen and phosphorous levels between the lakes.



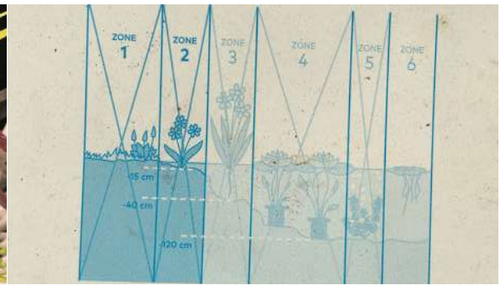
References
Poikane, S. et al. (2014). Defining ecologically relevant water quality targets for lakes in Europe. Journal of Applied Ecology 51, 592–602.
Poikane, S. et al. (2019). Deriving nutrient criteria to support 'good' ecological status in European lakes: An empirically based approach to linking ecology and management. Science of The Total Environment 650(2), 2074-2084.

25 | Aquatic plants used in the workshop

Team IILLAA
Author Lamiita Traista
Theme Research
Date 01.06.21
Appendix 25
Page 1 of 4

This WS is presenting the aquatic plants used in the workshop. The aquatic plants that we managed to find in garden centers in Copenhagen were only having their genus mentioned on the label, not the exact species name, thus this WS presents our research based on the genus name of the plants to assess whether they are suitable for Denmark.

Aquatic flowering plants



Caltha

"All species of Caltha prefer wet habitats. At lower altitudes, the genus is found in marshes and other wetlands [..] Caltha has a strong preference for cooler climates (or an avoidance of warmer climates) and is distributed in the moist temperate and cold regions of both the Northern and Southern Hemispheres." [1]

Caltha palustris - Marsh Marigold, Kingcup [2]

Approximate height: 30 cm
Recommended water depth over crown of plant:
0 - 7½ cm (zone 1)
Flowering time: March to April
Flower colour: Yellow

Iris

"[..] genus of about 300 species of plants in the family Iridaceae, including some of the world's most popular and varied garden flowers. The diversity of the genus is centred in the north temperate zone, though some of its most handsome species are native to the Mediterranean and central Asian areas." [3]

Iris laevigata 'Weymouth Blue' [4]

Approximate height: 60 cm
Recommended water depth over crown of plant:
0 - 10cm (zone 1)
Flowering time: May to June
Flower colour: Blue

Lobelia

"[..] genus of more than 400 species of flowering plants in the bellflower family (Campanulaceae) native to nearly all the temperate and warmer regions of the world, except central and eastern Europe and western Asia." [5]

Lobelia Siphilitica [6]

Approximate height: 80 cm
Recommended water depth over crown of plant:
0 - 5 cm (zone 1)
Flowering time: August - September
Flower colour: Blue

Primula

"[..] chiefly occurring in the Northern Hemisphere in cool or mountainous regions." (Britannica, 2013) [7]

Primula Denticulata 'Lilac' [8]

Approximate height: 30-50 cm
Recommended water depth over crown of plant:
0 - 10 cm (zone 1)
Flowering time: April-May
Flower colour: Blue-purple

Ranunculus

"Ranunculus (Ranunculaceae) plants, around 600 species, are globally distributed (Emadzade et al., 2011; Wang, 1995). Ranunculus is the largest genus of Ranunculaceae and can be found on every continent, from tropical to the Arctic and Subantarctic regions. It is particularly rich in temperate and Mediterranean regions. Ranunculus plants survive in various environments, from low-lying wetlands to the cold alpine mountains." [9]

Ranunculus flammula subsp. minimus [10]

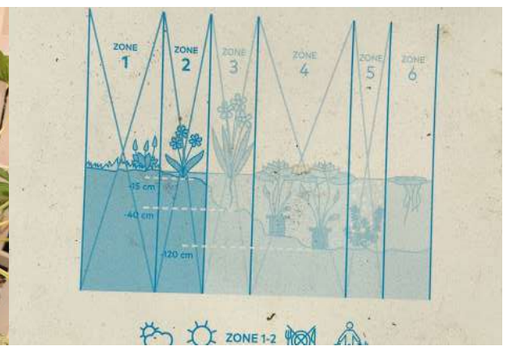
Approximate height: 30 cm
Recommended water depth over crown of plant:
0 - 5 cm (zone 1)
Flowering time: Late April to October
Flower colour: Yellow

References
[1] Schuettpelz, E., & Hoot, S. B. (2004). Phylogeny and biogeography of Caltha (Ranunculaceae) based on chloroplast and nuclear DNA sequences. American Journal of Botany, 91(2), 247-253.
[2] Water Garden Plants. (n.d.). Caltha palustris - Marsh Marigold, Kingcup. Retrieved June 1, 2021, from Water Garden Plants website: https://www.watergardenplants.co.uk/products/caltha-palustris?variant=8810722656299
[3] Britannica, T. Editors of Encyclopaedia (2020, September 17). Iris. Encyclopedia Britannica. https://www.britannica.com/plant/Iris-plant-genus
[4] Water Garden Plants. (n.d.). Iris laevigata "Weymouth Blue." Retrieved June 1, 2021, from Water Garden Plants website: https://www.watergardenplants.co.uk/products/iris-laevigata-weymouth-blue?variant=8925446176811

25 | Aquatic plants used in the workshop

Team	IILLAA
Author	Lamiita Traista
Theme	Research
Date	01.06.21
Appendix	25
Page	2 of 4

Aquatic insect friendly plants



Achillea

"Yarrow, any of about 115 species of perennial herbs constituting the genus Achillea in the family Asteraceae, and native primarily to the North Temperate Zone." [11]

Achillea Ptarmatica [12]

Approximate height: 75 cm
Recommended water depth over crown of plant:
0 - 5 cm (zone 1)
Flowering time: June-October
Flower colour: White

Geranium

"The genus stork beak, Geranium , consists of more than 400 species, which are widespread throughout Europe, Asia and North America." [13]

Geranium - Stork's Beak [14]

Approximate height: 30-50 cm
Recommended water depth over crown of plant:
0 - 5 cm (zone 1)
Flowering time: June-July
Flower colour: Blue

Lobelia

"[..] genus of more than 400 species of flowering plants in the bellflower family (Campanulaceae) native to nearly all the temperate and warmer regions of the world, except central and eastern Europe and western Asia." [5]

Lobelia Siphilitica [6]

Approximate height: 80 cm
Recommended water depth over crown of plant:
0 - 5 cm (zone 1)
Flowering time: August - September
Flower colour: Blue

Iris

"[..] genus of about 300 species of plants in the family Iridaceae, including some of the world's most popular and varied garden flowers. The diversity of the genus is centred in the north temperate zone, though some of its most handsome species are native to the Mediterranean and central Asian areas." [3]

Iris laevigata 'Weymouth Blue' [4]

Approximate height: 60 cm
Recommended water depth over crown of plant:
0 - 10cm (zone 1)
Flowering time: May to June
Flower colour: Blue

Lythrum

"Purple loosestrife (Lythrum salicaria), native to Eurasia and now common in eastern North America, grows 0.6 to 1.8 metres (2 to 6 feet) high on riverbanks and in ditches." [15]

Lythrum salicaria (16)

Approximate height: 120 cm
Recommended water depth over crown of plant:
0 - 10 cm (zone 1)
Flowering time:June to August
Flower colour: Pink

References
[5] Britannica, T. Editors of Encyclopaedia (2020, September 9). Lobelia. Encyclopedia Britannica. https://www.britannica.com/plant/Lobelia
[6] Jespers Nursery. (2020). Lobelie (Lobelia siphilitica). Retrieved May 7, 2021, from www.jespersplanteskole.dk website: https://www.jespersplanteskole.dk/lobelie-lobelia-siphilitica-flere-varianter
[7] Britannica, T. Editors of Encyclopaedia (2013, August 12). Primrose. Encyclopedia Britannica. https://www.britannica.com/plant/primrose-plant
[8] Jespers Nursery. (n.d.). Primula (Primula denticulata "Lilac") - Flere varianter. Retrieved June 1, 2021, from www.jespersplanteskole.dk website: https://www.jespersplanteskole.dk/primula-primula-denticulata-lilac-flere-varianter

25 | Aquatic plants used in the workshop

Team IILLAA
Author Lamiita Traista
Theme Research
Date 01.06.21
Appendix 25
Page 3 of 4

Myosotis

"Forget-me-not, any of several dozen species of the plant genus Myosotis (family Boraginaceae), native to temperate Eurasia and North America and to mountains of the Old World tropics." [17]

Myosotis scorpioides (Forget-Me-Not) [18]

Approximate height: 15 cm
Recommended water depth over crown of plant:
0 - 7 cm (zone 1)
Flowering time: May to September
Flower colour: Blue

Aquatic purifying plants

Acorus

"Acorus calamus (sweet flag) occurs in the wetlands of North America and from India to Indonesia. Other species are distributed in temperate areas in Asia and Europe, where they are often found at pond margins or along fast-moving streams." [19]

Acorus gramineus 'Ogon' [20]

Approximate height: 30 cm
Recommended water depth over crown of plant:
0 - 3 cm (zone 1)
Flowering: None (insignificant)

Alisma

"Water plantain, (genus Alisma), any freshwater perennial herb of the genus Alisma (family Alismataceae), commonly found in lakes, ponds, and ditches. The 9 to 11 species of water plantains are primarily distributed throughout the Northern Hemisphere, 3 being native to North America." [21]

Alisma Plantago-Aquatica [22]

Approximate height: 45 cm
Recommended water depth over crown of plant:
0 - 15 cm (zone 1)
Flowering time: June - August
Flower colour: White

Eleocharis

"The members are distributed throughout all the continents except Antarctica. [..] Eleocharis also has a number of species in cold temperate or even Arctic regions, although the great bulk of its 200 species are confined to warmer areas. " [23]

Eleocharis Acicularis [24]

Approximate height: 20-30 cm
Recommended water depth over crown of plant:
0 - 30 cm (zone 1 & zone 2)
Flowering time: May - July
Flower colour: White

Iris

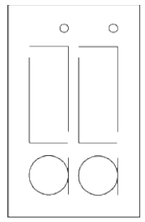
"[..] genus of about 300 species of plants in the family Iridaceae, including some of the world's most popular and varied garden flowers. The diversity of the genus is centred in the north temperate zone, though some of its most handsome species are native to the Mediterranean and central Asian areas." [3]

Iris laevigata 'Weymouth Blue' [4]

Approximate height: 60 cm
Recommended water depth over crown of plant:
0 - 10cm (zone 1)
Flowering time: May to June
Flower colour: Blue

References
[9] Hao, D.-C. (2019). Biodiversity, Chemodiversity, and Pharmacotherapy of Ranunculus Medicinal Plants. Ranunculales Medicinal Plants, (978-0-12-814232-5), 357–386. https://doi.org/10.1016/b978-0-12-814232-5.00009-5
[10] Water Garden Plants. (n.d.-c). Ranunculus flammula subsp. minimus - Dwarf Lesser Spearwort. Retrieved June 1, 2021, from Water Garden Plants website: https://www.watergardenplants.co.uk/products/ranunculus-flammula-subsp-minimus
[11] Britannica, T. Editors of Encyclopaedia (2019, June 11). Yarrow. Encyclopedia Britannica. https://www.britannica.com/plant/yarrow
[12] Lilies Water Gardens. (2021). Achillea Ptarmatica-9 cm pots. Retrieved May 7, 2021, from Lilies Water Gardens website: https://www.lilieswatergardens.co.uk/achillea-ptarmatica-9-cm-pots-p-3137.html

25 | Aquatic plants used in the workshop



Team IILLAA
Author Lamiita Traista
Theme Research
Date 01.06.21
Appendix 25
Page 4 of 4

Sparganium (Bur-Reed)

"Bur-reeds are the most common aquatic plant in Danish watercourses." [25]

Sparganium Erectum [26]

Approximate height: 30 cm
Recommended water depth over crown of plant:
0 - 30 cm (zone 1 and zone 2)
Flowering time: June - August
Flower colour: White / Green

Mentha

"Mint, (genus Mentha), genus of 25 species of fragrant herbs of the mint family (Lamiaceae). Native to Eurasia, North America, southern Africa, and Australia, mints are widely distributed throughout the temperate areas of the world and have naturalized in many places." [27]

Mentha aquatica [28]

Approximate height: 40 cm
Recommended water depth over crown of plant:
0 - 10 cm (zone 1)
Flowering time: August - September
Flower colour: Purple

References
[13] Plantorama. (n.d.). Storkenæb (Geranium) | Alt du skal vide om storkenæb (Geranium). Retrieved May 5, 2021, from www.plantorama.dk website: https://www.plantorama.dk/guide/have/haveplanter/stauder/udplantning-og-pasning-af-storkenaeb
[14] Jespers Nursery. (2020b). Storkenæb (Geranium himalayense ´Gravetye´). Retrieved May 7, 2021, from www.jespersplanteskole.dk website: https://www.jespersplanteskole.dk/geranium-himalayense-a-gravetyea
[15] Britannica, T. Editors of Encyclopaedia (2019, March 26). Loosestrife. Encyclopedia Britannica. https://www.britannica.com/plant/loosestrife
[16] Water Garden Plants. (n.d.). Lythrum salicaria - Purple Loosestrife. Retrieved June 1, 2021, from Water Garden Plants website: https://www.watergardenplants.co.uk/products/lythrum-salicaria?variant=8936540733483
[17] Britannica, T. Editors of Encyclopaedia (2017, April 21). Forget-me-not. Encyclopedia Britannica. https://www.britannica.com/plant/forget-me-not
[18] Water Garden Plants. (n.d.). Myosotis scorpioides "Mermaid" - Water Forget-Me-Not. Retrieved June 1, 2021, from Water Garden Plants website: https://www.watergardenplants.co.uk/products/myosotis-scorpioides-mermaid?variant=8942275559467
[19] Kress, W. John (2010, January 26). Acorales. Encyclopedia Britannica. https://www.britannica.com/plant/Acorales
[20] Water Garden Plants. (n.d.). Acorus gramineus "Ogon" - Golden Japanese Rush. Retrieved June 1, 2021, from Water Garden Plants website: https://www.watergardenplants.co.uk/products/acorus-gramineus-ogon?variant=8727436165163
[21] Britannica, T. Editors of Encyclopaedia (2017, December 28). Water plantain. Encyclopedia Britannica. https://www.britannica.com/plant/water-plantain
[22] Waterside Nursery. (n.d.). ALISMA PLANTAGO-AQUATICA (Water Plantain). Retrieved May 7, 2021, from www.watersidenursery.co.uk website: https://www.watersidenursery.co.uk/alisma-plantago-aquatica-water-plantain-british-native
[23] Reznicek, A. A. (2013, September 17). Cyperaceae. Encyclopedia Britannica. https://www.britannica.com/plant/Cyperaceae
[24] Jespers Nursery. (2020). Nåle-Sumpstrå (Eleocharis acicularis) - Flere varianter - Bestil nu! Retrieved May 7, 2021, from www.jespersplanteskole.dk website: https://www.jespersplanteskole.dk/eleocharis-acicularis-flere-varianter
[25] Kongeåstien. (n.d.). Bur-reed | Kongeåen. Retrieved May 5, 2021, from www.kongeaastien.dk website: http://www.kongeaastien.dk/en/content/bur-reed
[26] Jespers Nursery. (2020). Grenet Pindsvineknop (Sparganium erectum) - Klar til brug. Retrieved May 7, 2021, from www.jespersplanteskole.dk website: https://www.jespersplanteskole.dk/grenet-pindsvineknop-sparganium-erectum-klar-til-brug
[27] Britannica, T. Editors of Encyclopaedia (2020, February 28). Mint. Encyclopedia Britannica. https://www.britannica.com/plant/Mentha
[28] Water Garden Plants. (n.d.-e). Mentha aquatica - Water Mint. Retrieved from Water Garden Plants website: https://www.watergardenplants.co.uk/products/mentha-aquatica?variant=8939966201899