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Placemaking in a biophilic city: increasing biodiversity and pollinator protection in Tallinn's greenspaces

Kohaloome biofiilses linnas: elurikkuse ja tolmeldajate kaitse tõhustamine Tallinna rohealadel

Master Thesis

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Author’s Declaration

Hereby I declare, that I have written this thesis independently.
No academic degree has been applied for based on this material.
All works, major viewpoints and data of the other authors used in this thesis have been referenced.

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THESIS TASK

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Thesis topic:
Placemaking in a biophilic city: increasing biodiversity and pollinator protection in Tallinn's greenspaces

(in Estonian):
Kohaloome biofiilses linnas: elurikkuse ja tolmeldajate kaitse tõhustamine Tallinna rohealadel

Thesis main objectives:

1. Research and analyze the main issues related to biodiversity and pollinator protection in urban areas;
2. Explore the best options for a solution space;
3. Design a solution for supporting biodiverse urban greenspace creation and pollinators

Thesis tasks and time schedule:

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Abstract

The rapid and seemingly unstoppable urban sprawl is happening in metropolitan areas all over the world, including Tallinn. It is often associated with decreasing biodiversity, habitat loss for pollinators and a decline in the distinctiveness of the locale. The dissolving boundaries between the “wild” nature and the “cultured” that have existed for centuries have recently put to question and so are the old binary relational models between humans and nonhumans.

This thesis explores the evolving relationship between humans and pollinators probing the topic whose needs should the design of urban greenspaces put first. Building on research on biodiversity and pollinator protection and using the framework of nonhuman agency and placemaking, it poses a question on how to support biodiverse urban greenspace creation and help pollinators to become active and acknowledged subjects?

Research, including interviews with stakeholders, has been carried out, and systems design methodology is applied to give structure to the body of work.
Analysis of the research results suggests that growing the volume of biodiverse greenspaces through co-created environmental stewardship initiatives helps the urban population's sense of community and connection to place, as much as it improves the urban biodiversity. Through such actions, the status of urban pollinators can also be improved.

A new service platform is designed to be co-managed by all main stakeholders with a shared goal of following the principles of supporting biodiversity and pollinators in urban greenspace management and fostering a growing network of biodiverse greenspaces. The platform combines value-adding services with products gathered under a unified branded umbrella in order to offer holistic solution for all user groups.

The main goal of the platform is to create a sustainable home for both people and other urban species, with an emphasis on pollinators as the nonhuman actors.

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1. Introduction

Do bees belong in cities? Bees love it here, but do we love them – and many other urban species – back? What do bees and other pollinators require from the urban habitat, and how have people adjusted to such requirements? These are some of the questions I asked myself while choosing a topic for my thesis. "Bees are the new whales", "Save the bees – save the world" were slogans that I had seen posted frequently in various media outlets. Thus, my thesis project initially started by looking at the topic of urban beekeeping – an increasingly popular hobby amongst the younger generation of urbanites.

I was fascinated by the fact that more and more urban dwellers are flocking into beekeeping courses and are establishing apiaries in their back yards or rooftops. What is the underlying reason behind this, as it was apparent that all those people had not suddenly developed an insatiable appetite for honey? After talking to urban beekeepers, I discovered that besides delicious honey (and earning some extra coin), the reasons behind taking on such an exotic craft in the urban context lay many deep-seated aspirations and values. Discovering a deeper connection with nature, "doing something good" for it in return and finding means for switching one's brain off after a hard day's work at the office were pointed out as the main objectives for choosing the hobby.

Reading into the topic, I soon noticed that beekeeping is but a small piece in a much larger puzzle of urban biodiversity. Bees are irreplaceable pollinators; people have always admired their diligence and found their highly organized and societal way of living appealing – almost as a model for our cities and settlements – but bees (and other pollinators) need more than a hive or "house": they need forage, meaning access to an abundance continuously flowering nectarous plants. Plants, in turn, demand green spaces and specific maintenance – the circle grows larger and larger. It takes is a whole ecosystem to build a home for pollinators and people. How many of these needs are, in reality, covered in the urban environment? Are urban dwellers even concerned about pollinator protection, and do they have the tools and know-how to take this matter into their own hands and is the city motivated enough to contribute into this matter?

The broader topic of integrating pollinator protection into the urban environment also progressively sparked more interest for me than focusing solely on beekeeping. Urban beekeeping as one aspect of pollinator protection has remained within the scope of the thesis but was no longer the singular focal point. It is the larger, more systemic view on increasing urban biodiversity in cities, especially my hometown Tallinn, that makes up the scope of the work.

If we want to create a more sustainable and attentive urban environment, we must evolve from the current point of view that we build cities to accommodate just people and design solutions for supporting the growing urban population, and at the same time, protect the drastically deteriorating ecology. Designing future cities in a way that increases biodiversity can create a more sustainable setting for urban biodiversity and the ecosystem services (e.g., pollination) they provide. Pollinators who have rendered into only providers of the valuable "pollination services", should also be recognized as stakeholders in deciding the course of our and their shared habitat. It is also important to note that in order for such biodiversity initiatives to be effective and on point, they need to take into account the local

social and ecological context but also rely on shared ecological thinking and social relationships.

We are approaching a new geological epoch, the Anthropocene – an era wherein humankind is responsible for altering the functioning of the Earth system (Boehnert, 2018) up to its core. Much of the environmental and climatic change leading to this new epoch has been directly or indirectly generated from urban areas. Despite the proximity of many cities and towns to intact ecosystems, humans are becoming more and more detached from nature, with potential ruinous effects for biological conservation (Ossola & Niemelä, 2018, p.4). Both biodiversity and the natural environment are in a deep crisis, the main cause being too intense and careless use of Earth, which has led to rapid loss in habitats.

Many people consider biodiversity as something associated with wilderness and rural areas, but biodiversity is also present in cities and urban areas, and one of the main reasons we don't notice or talk about it so often in that context, is why we need to value and protect it. Research also shows that cities support more biodiversity than previously thought (University of California - Santa Barbara, 2014).

Ahmed Djoghlaf, executive secretary of the U.N. Convention on Biological Diversity has said: "The battle for life on earth will be won or lost in urban areas" ("Cities Should Do More to Protect Nature," 2008). This quote might sound somewhat pretentious, but when we look at the following numbers, then the statement does not sound that extreme any longer: the IPBES (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services) review from last year concluded that during the last 50 years we have destroyed nearly 50 percent of habitats and pushed one in every eight species to the brink of extinction, with every fourth one now deemed endangered (Watson et al., 2019).

In Estonia, PhD Aveliina Helm, ecologist and leading expert on biodiversity, has pointed out that although we tend to think that we have a large amount of relatively unspoiled nature at our doorstep, Estonia is no exception here. Within the last hundred years, we have lost 95 percent of our meadow ecologies, the bastion of our biodiversity. Biodiverse wooded meadows, which as little as 70 years ago spanned over 850,000 hectares, have shrunk to a thousandth of that, amounting to 800 hectares. Due to habitat loss the number of birds in Estonian forests and fields shrinks by 57,000–111,000 pairs per year. (Helm, 2019)

When we think about Tallinn, the city looks noticeably green, and compared to many other tightly packed cities in the world, it very much is so, there is still a lot room for improving and enriching the green spaces: in the hands of both private and municipal stewards.

Tallinn is the initiator of the European Green Capital Award in 2006 and is applying for the third time for the title but, quite paradoxically, has never won the title herself. The cities who previously have won the award, have worked on reducing the carbon footprint of the city and on environmental protection (including establishment of green corridors as part of urban environment) and favoured co-creation in these matters. As Tallinn lacks most of these measures, some critics have used the term grey capital, instead of green capital while talking about the city (Karro-Kalberg, 2019)

According to an interview (Uustal, M., personal communication, February 10, 2020), the city is not really invested in biodiversity issues as the citizens don't push the topic enough and the citizens don't push the topic because of low awareness, so we are trapped in a vicious circle.

1.1. Shifting paradigms

The main paradigm shift illustrating the topic of biodiversity and pollinator protection stems from the previous outlook that cities are opposed to the wild (or somewhat wild) nature surrounding them, thus insects, animals, weeds and wild meadows have no place in the cultivated urban environment. As wilderness and nature used to be viewed as related to the natural environment, so was nature conservation and protection. Urban environments were considered as bare, barren concrete jungles with no nature to protect (Douglas & James, 2015, pp. 11-17). This opposition, the *urban-rural divide*, doesn't support the evolving Anthropocene: there simply isn't enough countryside left soon as sprawling cities swallow large pieces of non-urban landscape.

According to urban ecologists, such integration between cities and the urban fringes have many dimensions, such as livelihood; lifestyle, long-distance connections, and form, or characteristics of a place. This illustrates the variety of urban environments, with a wide range of habitats and high biodiversity with a lot of natural "material" to work with – and design for (Douglas & James, 2015, pp. 14-17).

Designers from the art and design association Cumulus (Tischner et al., 2015) have tackled the topic of a changing paradigm in the field of design. According to designer Peter Stebbing from Cumulus, the old design paradigm, operating within a milieu of neo-liberal capitalism and 'brown' economy based on the fossil fuels and limited resources, and regardless of environmental degradation, ecosystem loss and pollution, did not recognize the future of the planet as a design concern. The new design paradigm sees the future of the planet and sustainability as critical design concerns and the milieu in which design now operates, is the 'green' economy (Tischner et al., 2015). Stebbing suggests that as designers, we need to :

"/… / design the care of Nature into our lives and become Earth Stewards so that through a variety of activities we increase the World's Natural Capital, its ecosystems and biodiversity" (Tischner et al., p. 25, 2015).

To conclude, the far-reaching effects of climate change and efforts of ecologists have finally caused people to see urban environments as part of the overall ecology scene and worth protecting and designing for. There is an imminent need for a paradigm shift that integrates biodiversity into the urban fabric, as we are slowly accepting the fact that cities are also the home for many insects, fauna and flora, and offer us invaluable ecosystem services. The least we can do in return is to protect this ecosystem that we all live in by protecting the habitats and life of its creators.

2. Theoretical framework and methodology

After initial research, it became evident that there is a strong connection between urban biodiversity and the concept placemaking, especially if taking into the account the urban-rural divide of cities being opposed to the countryside and natural environments. Surely, cities should also foster the various aesthetics and common practices or hobbies of their population.

"The urban dweller can be liberated from the dichotomies of city and country, artificial and natural, man versus other living things, once the city can be accepted as being as natural as farm (Thomas, 2016, p. 126)".

Therefore, placemaking together with agency of non-humans (pollinators) and methods of systems design provides a framework for the thesis.

2.1. Placemaking in the urban context

Designer and author E.Manzini (2015, pp. 189-191) writes that people simultaneously live in a social and a physical space, therefore also their interactions also occur in both spaces. In the first they produce social forms, while in the second they produce *places*. Together they create society and the environment in which societies assemble. (Manzini, 2015, pp. 189-191) A place in the context of urban environment is defined as a meaningful site that combines location, locale, and sense of place (Thomas, 2016, pp. 23-26). According to Thomas, locale refers to the material settings for social relations (buildings, streets, parks and other visible aspects of a place).

A place is considered as a space that is distinctive in character and the sense of place refers to meanings and familiar associations (individual or shared) with a place, the feelings and emotions a place evokes (Thomas, 2016, pp. 23-26). Manzini agrees that a place is a space endowed with sense – a space, that is meaningful for someone. People, as cultural beings, have a need to have stable system of places to depend on, thereby providing emotional attachment and *identity* with the place. People are builders of their own environment (Thomas, 2016, p. 89).

For the people who live in a certain place, recognizing the value of the place goes hand in hand with sustainable well-being. We must therefore understand how much places and healthy environment contribute to quality of life (Manzini, 2015, pp. 189-191). Manzini notes that if we aim to design for social innovation, we have to take into account the dimension of place making: the existence of a variety of places is essential for the existence of resilient natural, social, and production system: "one that is capable of adapting to unexpected events and lasting over time. "

Philosopher Ivan Illich wrote in in his book "Tools for conviviality" (1973, p. 12):

"People need not only to obtain things, they need above all the freedom to make things

among which they can live, to give shape to them according to their own tastes, and to put them to use in caring for and about others." According to Illich, the re–establishment of an ecological balance in society depends on its ability to counteract the progressive materialization of values. Otherwise people will end up enclosed within their artificial creation, with no exit.

Designer and author I.F.Lee asks in her book “Joyful: the Surprising Power of Ordinary Things to Create Extraordinary Happiness" (2018) about the connections between design and joy that if nature makes us healthy and free, as is proved by many studies, then why don't we have more of it in our lives? She refers to J.B.Jackson, a landscape theorist, who remarks that people have long preferred to focus on the traits that distinguish us from other species rather than put themselves on the same level with other living creatures. The built environment mirrors this anxiety and ignoring our biological needs. In Jackson's view, our cities are designed to make us feel separate from nature. Lee adds that for most of human evolution nature was not a place we went but *a place we lived,* and now that more than half of the world's population lives in cities, the need to restore access to nature feels increasingly urgent. (Lee, 2018, pp. 80-102)

Thus, it is important to keep in mind that in order to create meaningful and convivable urban space, urban designers have to leave room for the locale, the characteristics of the habitants and give them freedom to shape their environment according to their desires. This also means incorporating the joy of nature into the urban mosaic.

2.2. Posthumanism and agency of nonhumans

In 2017 the Whanganui River in New Zealand was granted the same legal status as a human being after a local Māori tribe fought for its recognition as an ancestor. They argued that the river should be regarded as a living entity rather than a resource that can be owned and managed. By granting the river legal rights, crimes against the river can now be treated as crimes against the tribe. This can be seen as an example blurring the lines between boundaries between human and non-human, culture and nature, human and animal that have dominated our world since the Enlightenment, bringing the topic recognizing the agency of non-living animals (Forlano, 2017).

Nancy Carranza from the University of California (2018) explains the main ideas of the concept of agency within the framework of posthumanism philosophy as follows:

> *agency is defined as “the ability to act in such a way as to produce particular results" and emphasizes the activities and responsiveness of nonhuman and matter besides the traditional humanist subject, which for centuries, dismissed nature of all purpose, sentience, and agency. According to posthumanist thinkers, an actant is something that acts or to which activity is granted by others and is not reserved for just humans. On the contrary, agentic capacities are extended to nonhuman – to anything that has the ability to alter the course of events by their action.*

It should be noted that this does not exempt humans as being identifiable agents and relieve us of the disasters caused by us within the Anthropocene. What it does, is to encourage us to bring on a more bio- and eco-centric environmentalism and a stronger connection between “us" and “others", including the non-human agents. It can also push

us towards producing more ethical relations with the environment and non-human life forms and having the agency of non-humans in mind while designing for the (urban) environment.

Considerations of the nonhuman (in this case, pollinators) and the natural environment (the City), or even things — require new forms of expertise and open up new problems, questions, opportunities, but also solutions for many fields, including design. As environmental, social and technical changes change our understandings of the human world, it is possible to make way for new design practices that take such stakeholders and perspectives into account.

I strongly believe that by encouraging people to pursue projects that create biodiverse greenspaces also acknowledging status and needs of pollinators, we can also help to build better communities.

2.3. Systems design

In structuring my thesis project, I chose to follow the *systemic approach*, as described by designer and design researcher Jodi Forlizzi (2013). The systemic approach is also supported by the concept of systems ecology, considering an ecosystem as an integrated and interactive system of biological and physical components. Hence, this branch of ecology reflects most explicitly the systems view of life (Capra & Luisi, 2014, p. 345).

Systemic designer Birger Sevaldson (2019) describes systemic design as an organic meshing of systems perspective with design, and adds: "The systemic approach to systems is concluded in the realisation that systemic design, with its management of complex data through visualisation, reaches beyond the sharing of data, information and factual knowledge, leading to analyses and modelling."

Designers and authors Harold G. Nelson and Erik Stolterman also argue in their book “The Design Way: Intentional Change in an Unpredictable World" (2012, pp. 57-93) for systemic design and thinking: designers must be systemic in everything they do and make; otherwise their way of working is fundamentally unsustainable will not contribute to sustainability in the long run. A systems approach is also reflected in pollinator protection as it reveals urban pollinator hotspots and conservation opportunities (Baldock et al., 2019), tying the methodology closer to my topic.

2.3.1. Product Service Ecology

I have used the Product Service Ecology (PSE) process model adopting a systems approach, introduced by designer Jody Forlizzi (2013) which allows designers to look at problems holistically, understand the system and its part-whole relationships.
PSE can be used to focus on small details such as individual product features, or wider arguments and the context of the system and to design new systems of artifacts, products, services, and other systems. PSE unfolds into a four-part iterative process: synthesis,

analysis, redesign, communication, all steps being iterative and nonlinear in time and as a process (Fig 1).

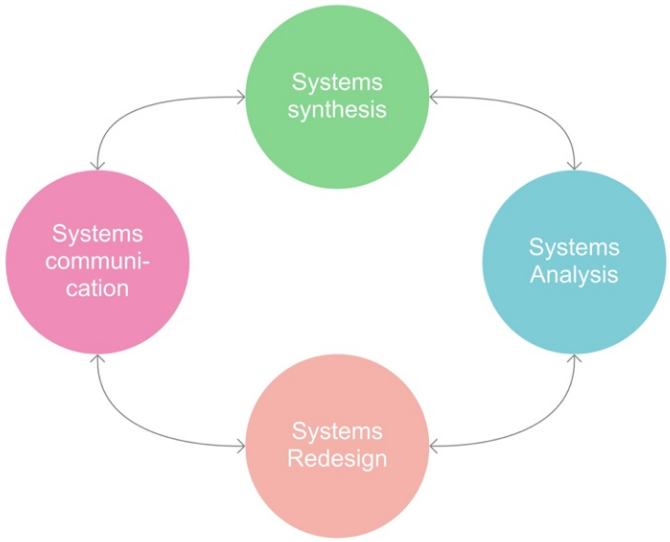

Figure 1: Author's version of Product Service Ecology diagram applied in this thesis

The first step in using PSE is to *synthesize* the ecological system under study and comprehend the system holistically. It is also critical to think about the stakeholders involved.

The systems *analysis* phase incorporates the insight from the previous phase in order to uncover the structure of the ecological system and understand the structure, organization, and interconnections of the system as it relates to the whole.

In the systems *redesign* phase, plans and solutions take shape for establishing a new and enhanced ecological system into place by creating and evaluating many potential framings with stakeholders to refine the form and eventual structure of the system. This can be done by creating a service blueprint map.

The systems *communication* displays the outcome of an improved future state. The planned ecological system can be represented using models, diagrams, experience maps, scenarios, prototypes or enactments.

Though I don't follow Forlitzi's method verbatim, it helped to create a clear structure for the thesis following the systems-bound approach that collides with the systems way of life and urban ecosystems.

2.4. Research question and hypothesis

From the initial research, I gathered that if humans are by default put at the centre of urban (greenspace) design, then environmental sustainability cannot be considered justly, as the

same habitat is also the home for a variety of different nonhuman species. Based on this notion and focusing on achieving the main goal of the project – to design a solution for supporting and increasing biodiversity and pollinator protection in Tallinn and recognize the agency of pollinators –, I posed the following research question:

How to support biodiverse urban greenspace creation and help pollinators to become active and acknowledged subjects?

With the help of the research question I constructed the following hypothesis:

Extending agency to pollinators and acknowledging their role in the urban habitat and creating a network of biodiverse greenspaces improves the quality of life and wellbeing of people, as well as pollinators and other nonhuman urban species.

The research question and hypothesis serve as tools for designing a solution tackling the current lack of biodiversity and sense of place in the urban environment and not realizing the importance, as well as the position of pollinators in this context.

2.5. Interviews and documenting

In addition to desktop research on urban biodiversity and pollinators while using the framework of placemaking and pollinator agency, my thesis also includes qualitative interviews with stakeholders, as well as documentation, though, due to the emergency situation caused by Covid-19 virus pandemic, on a much smaller level than I had hoped for), and in the concept development phase user testing.

The first interviews were carried out with urban beekeepers from Tallinn in order to find out more about the reasons why people take up this hobby, what are their main "pains and gains". I interviewed five urban beekeepers and PhD Liisa Puusepp, an ecologist and professor from Tallinn University who also takes an interest in urban beekeeping and has conducted analysis on urban honey and pollen (Puusepp, L., personal communication, December 5, 2019).

As my thesis steered more and more towards the topic of urban biodiversity and pollinator protection rather than just urban beekeeping, I decided to interview people with valuable insight in this subject matter. I contacted Anu Leisner from the Putukaväil (Insect Highway) project (Leisner, A., personal communication, December 6, 2019) and conducted a joint interview with Estonia's ecologist and leading biodiversity advocate A.Helm; accompanied by Mart Meriste, another renown biodiversity spokesperson, and Karin Bachmann – landscape architect and author who applies the principles of biodiversity practices in her work (landscape design for Estonian National Museum and Roosi Street in Tartu (Helm et al., personal communication, December 18, 2019).

I also conveyed an interview with environmentalist Meelis Uustal from the Tallinn Urban Environment and Public Works Department (Uustal, M., personal communication, February 10, 2020) and during the concept development phase, carried out user testing. Interview findings are included in the next chapters.

During the winter months of 2019/2020 I also participated in the process of establishing a community garden in Kollane Street, Kadriorg (Jürgens, 2019). Biodiversity as an important component of the garden was included in the garden concept from the very first sketches. I had hoped to engage the founding members of the garden in co-designing workshops related to my thesis (and for the benefit of the planned garden), but due to the unfortunate circumstances this spring (emergency situation and lockdown caused by the Covid-19 virus), my plans were cut short as the funding of the community garden by the City was frozen until further notice and meetings of the gardening project were therefore also put on hold.

3. Biodiversity and pollinators: a systems synthesis

As the technique of PSE suggest, the first step in the model is synthesizing the current situation. During synthesis, the system is interpreted factually and logically with the goal of understanding as much as possible. A literature review must be performed that positions the work and demonstrates how a particular system framing can be taken into consideration (Forlizzi, 2013).

In this thesis, the synthesis consists of the literary review and insight from interviews on urban biodiversity, urban ecology and pollinators amalgamating the resulting insight into an input for the next phase (systems analysis).

3.1. Urban biodiversity and urban ecology

Figure 2: Urban nature. Credit: Khara Wood. Source: www.unsplash.com

The term urban biodiversity – the variety of species richness and abundance of living organisms and habitats found in and on the edge of human settlements – appeared in the academic literature for the first time after the first Convention on Biological Diversity held in

1992. Urbanocentric landscape ecologist Richard T.T. Foreman (2013) pointed out that most urbanites like and appreciate than nature around them but for many years most ecologists considered urban nature and ecological conditions to be "severely downgraded, bulging with bad contaminants, invasive weeds, waste sites, sewage overflows, traffic pollutants, pigeons, pests, and pathogens". Thus, research on urbanisation was mainly directed towards the negative impact of urbanisation on ecosystems and biodiversity. Such stigmatisation can distract and undermine the existence and of high levels of biodiversity that often flourishes inside cities and the positive effects that urban biodiversity has on ecosystem services and human wellbeing (Beninde et al., 2015, Ossola & Niemelä, 2018, pp. 36-47). However, cities and ecological conditions are inherently neither good nor bad (Forman, 2013, pp. 1-30). However, growing urbanisation and climate change continue to pose a significant threat to global biodiversity.

Urban ecology is the study of ecosystems that include humans and urban landscapes highlighting all the spaces within an urban area: not just parks and other greenspaces, but also the wide variety of built spaces. Thus, it can be called as an ecology of *urban mosaics,* focusing on the combination of natural and human patterns (Forman, 2013, pp. 31-64). Other criteria, such as some physical or biological environmental measurement (e.g. pollution, or dependence on an economy based on consumption, finance, transportation, versus dependence on agriculture or management of natural resources), can be used to compare urban and rural sites (*BES Urban Lexicon*, 2012). Urbanisation has a strong effect on nature, mainly in the form of perforation and dissection of greenspace, followed by fragmentation and shrinkage.

Various research and experiments have concluded that being in the presence of natural elements helps people to feel good linking human health and biodiversity. However, studies have also proven that *the level of diversity* is also relevant to the public. If people perceive an area to have higher biodiversity, then it may be more likely to impact their wellbeing due to the perceived extent (Fuller et al., 2007). Therefore, merely providing parks and other green spaces overlooks the fact that greenspaces can vary drastically in their contribution to human health and biodiversity provision. This shows that education about biodiversity and our role in it is key to designing for a more sustainable and diverse urban environment.

The ecology of cities also means looking at the different animals living there and the nature of animal-human contact. Such contacts have been proven to influence humans' sense of self, for example, whether they are a 'dog person' or a 'bird watcher' or a 'wildlife rescue volunteer' – or according to recent trends, a beekeeper. Pets also serve as a catalyst for social interaction in public spaces. Wildlife might also contribute to human health and can benefit human wellbeing by giving providing an attachment relationship for people and 'their' urban animals or birds (Taylor & Hochuli, 2015).

Such notions pose material for a further discussion on what animals are considered pets and should we add perhaps new species into this list? Urban beekeeping is already on the rise, as chicken have become popular and sought-after gifts. At the same time, we should look deeper into how the potential, agency, and power are distributed across humans and the nonhuman species at the centre of the urban ecology.

To conclude, as mentioned earlier, the blending of the distinction between cities and urban areas create many new urban habitats and a need for a new means for managing the wide arrays of different, yet equally important urban habitats. The previous harsh critique on the urban environment shows that there exists a need for absolving the urban perimeter from this often undeserved assessment and propose means for designing an urban environment that cherishes the richness that urban gardens and green spaces can offer us.

3.2. Urban greenspaces

The urban mosaic consists of a blend of different urban greenspaces (UGS). I will touch upon a small selection from a much broader topic – selected topics that offer the most within the scope of my thesis and best describe the threats to biodiversity and pollinators in those areas.

Household and community gardens

Recently, there has been an upsurge of interest in urban agriculture in many European countries. Urban agriculture takes on many different forms: household, school and community gardens, as well as rooftop, vertical and indoor farms. By growing a variety of plants from around the world, gardeners can play an essential role in ensuring that a range of food sources is available for many different pollinators. Research demonstrates those theories can also be applied globally, to the potential benefits of people and communities across the world (*Scientists Show Cities Can Serve as a Refuge for Insect Pollinators*, 2016).

Household urban gardens are usually not designed to encourage wildlife, rather concentrate on visual effects and a nice view from a window. They are often characterized by geometrically arranged single species in rows or clumps, not touching each other, and leaving considerable bare soil between them (Douglas & James, 2015, pp. 363-364). However, research has also shown that plant diversity can be extremely high on a house property (Forman, 2013, pp 314-342) and residential gardens and community gardens are often quite the pollinator 'hotspots'. M.Uustal, environmental enthusiast and Lead Specialist of Environmental Protection at Tallinn City Council also pointed out the potential of residential gardens for biodiversity and pollinator protection in Tallinn (Uustal, M., personal communication, February 10, 2020).

There is also an ongoing controversy about whether gardens with native species are more appropriate than those "adorned with exotics" (Douglas & James, 2015, pp. 363-364). A concerning sign is that household income is positively associated with pollinator abundance in gardens, highlighting the influence of socio-economic factors (Baldock et al., 2019).

Community gardening trend is clearly on the rise in Tallinn as well, copying the course of action in many other Western-European and North American cities. At the moment (spring 2020), there are currently 12 community gardens in Tallinn with four more gardens on the way. Many gardens are established in cooperation with local residential societies and 30 schools bolster garden plots with garden beds. As one of the initiators of a community garden in my neighbourhood, I can attest to the fact that incorporating biodiversity (and using plants preferred by pollinators), was a vital part of the concept from the very first sketch. Incorporating these ideas into the initial project was achieved due to many members having a background in landscape architecture and gardening. Nevertheless, it was a sign that community members care about pollinators and that they have become aware of this issue due to education and insight from experts and scientists.

Unused urban spaces

Sustainable design advocate John Thackara (2015, pp.62-67) writes about a new wave of "greening designers" who are working with human-made assets like parks, cemeteries,

watercourses, avenues, gardens, and yards. They see roadside verges, green roofs and facades as space where to plant. Sports fields, vacant lots, abandoned cites, and landfills can be repurposed and empty lots to be modified into lush green spaces. On the other hand, minuscule micro gardens can be created in cities from tiny plots of land.

Green corridors and networks

Green urban corridors connecting wildlife populations separated by human activities or structures, usually situated along streams, powerlines, pipelines, property boundaries, railways, coastlines etc., provide a wide range of benefits: a flow of air, water, animals, seeds, and/or people and are major centres of ecological and human activity (Forman, 2013, pp. 343-371).

Forman (2013, pp. 343-371) explains that green networks (strips of land enabling a bridge of habitat populations otherwise dissected by human actions) are especially important in providing *connectivity* for species or people. Green corridors are generally optimal for both human and wildlife movement but establishing sufficient green corridors in cities is usually extremely difficult.

Blandscaping

What are the current drivers behind UGS design and management? Experts have identified the prevailing aesthetics and recreation (Connop, 2018) as the main culprits leading to the simplification of habitats through frequent mowing, cutting back trees and shrubs, removing leaves and branches and mulching. The term “blandscaping" has been coined for describing landscaping that uses the same designs, and often the same species and has become a “best practice" model that has been shared and used across different urban regions nationally and globally.

Connop (2018) notes that it is also important to recognize that due to aesthetic principles or *ease of management*, many people have favoured cultivated varieties over native species. Such actions can decrease the value of UGS for biodiversity as it will consist of a small range of introduced, often non-native species that can tolerate the conditions created by humans. These practices have created both structurally and functionally similar urban ecosystems, which are distinct from local native ecosystems but are close to each other—a phenomenon called urban *biotic homogenization*.

Estonian writer Jaan Kaplinski calls the bland, over-manicured green lawns dominating our parks and gardens *green deserts*: although they are lush and green, they lack flowers, life and diversity (Kaplinski, 2019). Kaplinski very aptly also points out one of the main reasons behind this empty greenness (besides obvious political reasons on a larger scale that nature is here to provide for us, not *vice versa*) – the deep-rooted need to “tidy up" nature. In the article, Kaplinski also recognizes an opposition between nature and the “unrefined" wilderness (Kaplinski, 2019).

To conclude, linking smaller, often inconspicuous greenspaces (private gardens and yards, small neighbourhood corridors, such as lines of street trees, side-boundary hedges and fences) that are of considerable ecological importance, carries a great potential for providing shelter and safe havens for pollinators and other urban life. Ideally, these small urban mosaics can be merged into larger corridors or networks and possibly, even networks.

It is also time for us to let go of this role and take up the role of a protector and stewards, rather than owner and heir on nature. In order to fight for higher biodiversity, we must change the predominant aesthetic of green manicured lawns and carbon copies of the same “ideal", easy-to-maintain garden. More freedom and assortment and less uniformity would contribute to a stable ecosystem for pollinators and plants and a place of joy and conviviality for the urbanites.

3.3. Pollinators

Figure 3: Bumblebee by Mart Moppel. Source www.flickr.com

Pollination can be achieved by wind and water. However, the majority of the global cultivated and wild plants depend on pollination by animals: between 75% and 95% of all flowering plants need pollinators for reproduction. Although most animal pollinators are insects, some vertebrate pollinators exist. Bees are an essential group of pollinator with over 20,000 bee species described worldwide with *Apis mellifera* (the Western honeybee) being the most commonly managed bee in the world. However, the roles of wild pollinators and assemblages of diverse pollinators is being increasingly recognized (Potts et al., 2016).

The main threats for pollinators in urban areas are habitat fragmentation and degradation. A decrease in pollinators can lead cities to ecosystem instability, a decline in pollination levels, decreased seed dispersal, plant damage and food shortage and decline in birds (Forman, 2013, pp 241-274).

Regarding pollinators, in my thesis, the focus is set on pollinating insects, such as bees (honeybees and bumblebees) as butterflies.

Pollinators assessment in Estonia

There are 285 bee species present in Estonia including 28 bumblebee and 256 solitary bee species. The condition of 44% of Estonian bee species is considered to be satisfactory. Eighteen bumblebee species are listed as protected, and two bumblebee species are endangered. The number of different butterfly species in Estonia is 98, 8 of which are protected. The status of butterflies in Estonia is currently quite good (Sõber et al., 2019).

The main threats to pollinators in Estonia are compatible with those in all over Europe: intensive agricultural land use, growing cities, infrastructure development and dismissing traditional ways of farming (Ferrier et al., 2016). The majority of bees and butterflies need heterogeneous, semi-natural habitats with a variety of vegetation and are thus threatened by habitat and forage loss, especially in cities, but also in the countryside where the use of pesticides, monocropping and loss of semi-natural habitats are endangering our pollinators.

Pollinators and ecosystem services and disservices

Urban ecosystem services are defined as the benefits humans derive from urban green infrastructure and other unplanned green and blue spaces in cities. A range of ecosystem services occurs when ecosystems are healthy and functioning (Ossola & Niemelä, 2018, p. 2) and are the outcomes of the "functioning diversity" that support human existence (Taylor & Hochuli, 2015). However, ecosystem services exist independent of their benefits to humankind.

The benefits humans derive from pollinators are considerable. Three-quarters of the world's main food crops and over a third of the global food production benefit from animal pollination, with both wild and domestic bees comprising the most critical species groups. With an estimated 87% of all flowering plant species dependent on insect pollinators for sexual reproduction, pollinator-plant relationships may be one of the most ecologically important animal-plant interactions (Ossola & Niemelä, 2018, pp. 36-48.

Pollinators are integral elements in many regulating and cultural ecosystem services. Either directly or indirectly, they contribute to an improved quality of life for many people – through heritage, aesthetics or identity (Ferrier et al., 2016). Pollinators and their products are also sources of inspiration for art, music, literature, religion, traditions, technology and education. International agreements for safeguarding cultural heritage explicitly include several heritage values that depend on peoples' interactions with pollinators and pollination webs, as stated by UNESCO (Ossola & Niemelä, 2018, pp. 36-48).

Despite numerous benefits, urban biodiversity and pollinators may provide, urban green infrastructure has also been related to several adverse effects on human well-being – so-called ecosystem disservices. The disservices can be divided into physical, psychological and societal disservices. The first include, for example, pollen allergies, mosquito bites, bee stings, destruction of infrastructure by wild animals. Psychological disservices describe negative feelings, such as fear and disgust of unsafety in urban parks and forests. Societal disservices are negative impacts that are indirectly linked to UGS, such as increased crime rates in urban parks, or ecological gentrification (Ossola & Niemelä, 2018, pp. 36-48).

Therefore, the disservices should also be taken into account while designing for a more diverse city. People's fear of bee stings and allergies also came out as a recurring theme from my interviews with beekeepers from Tallinn, often being the main reason why people are opposed to having beehives near their homes (Marko, personal communication, November 8, 2019) .

There is still a long way to go in educating people about that fact that if hives and bees are managed properly, they do not pose any risks to most people. Fear of ticks and mosquitos was also brought out by the interview with the Insect Highway project manager (Leisner, A. personal communication, December 6, 2019).

Bees as a proxy for biodiversity assessment

Due to bees' integral role in the reproduction of flowering plants, bees can function as indicator species for the status of the flowering plant community (Stange et al., 2017). The distribution of bees' habitat suitability can, therefore, serve as a useful presentation of urban biodiversity. Consequently, pollinators serve as a useful proxy for assessing urban biodiversity. Stange *et al.,* conclude that according to recent assessments concluded that as many as 10% of European wild bee populations are in danger of extinction.

Urban planners may use maps of pollinator abundances to identify greenspace areas with particularly high biodiversity values that are worthy of protection from future development, as well as areas where biodiversity values may be lacking and would benefit from restorative measures (Stange et al., 2017).

Protecting pollinators

There are two main opportunities to improve the conditions for pollinators in urban areas:

1. Increase the quantity of land favourable to pollinators by converting currently unfavourable land to better quality land uses (e.g. converting parks into gardens or allotments).

2. Improve the quality of existing land through better management of current land uses for pollinators (e.g., increasing the number and quality of floral resources available in publicly managed greenspaces) (Baldock et al., 2019).

Individual actions in pollinator protection add up. The choice about which plants to incorporate into gardens, hanging baskets and window boxes make the difference between an urban environment that is conductive to insects and on that is not (Douglas & James, 2015, pp. 362-363). Gardens can be filled with plants rich in pollen and nectar. People who don't have a garden should check whether public spaces, parks and road verges are bee-friendly and find ways how they can improve.

Although pollinators have been widely recognized as agents of pollen dispersal, their position and agency in urban greenspace design and management have still often been overlooked. The interests of pollinators should, therefore, be equally considered with the similar interests of other moral beings, such as humans, while making decisions about urban greenspace management and creation.

In conclusion, providing a network for effective species movement across urban areas, coupled with large protected habitats as well as small biodiversity “hot spots" and a change in greenspace management can produce promising results for protecting species richness and pollinators, but also create welcoming and delightful greenspaces for people.

3.4. Urban beekeeping

Figure 4 Beehives on top of Nordic Hotel forum. Credit: Lauri Laan, www.nordichotels.eu

Urban beekeeping is on the rise: CCD (Colony Collapse Disorder) – a crisis caused by a combination of many factors (parasites, mites, pesticides, industrial shipping) has gained much public interest since 2006 raising concerns over environmental sustainability. Boosted by an interest in urban farming, locavore food movements, green consumerism, DIY culture, and demand for gourmet honey, a growing number urban bee colonies are being established in cities around the world (Moore & Kosut, 2014).

Bees are nowadays welcomed in cities across the world: NYC, Paris, Oslo, Ljubljana, Stockholm, London, Vancouver, Copenhagen, and Tallinn, among many other cities. In London, the number of beehives has tripled in a decade reaching 5500 (Wright, 2017). Such an increase means London now has the densest population of honeybees in Europe (Sampson, 2019). Beekeeping has become so popular amongst Londoners that beehives are featured in the top of John Lewis' shopping centre's wedding gift list, and are contributing to excess urban bee populations (*Trend for Owning Beehives in Cities Is Bad for Insects and Birds*, 2016). Many corporations are interested in propping up beehives on their roofs – this trend is already manifesting in Tallinn as well, albeit much slower. Even our president has hives in the garden of her residence.

One reason behind the popularity of urban beekeeping (UBK) is the goal of "saving the environment and the bee". "Saving bees" has become a means of grass-root activism for "saving the planet" and has entered the interest of media. This saving takes many forms, from green consumption to lobbying for policy change to doing urban beekeeping as a hobby. These actions can seem inert, either too small (buying locally grown food or honey) or too large (ending monocropping agribusiness)", as sociologists Moore and Kosut write in their book about urban beekeepers in New York (2013, pp. 58-69).

Learning about and caring for bees can be seen as a way a person tries to make sense of the world in cities. It also collides with the initiatives of the greening of cities. Urban farming and gardening, and UBK are all tied to larger cultural trends, personal lifestyles, and philosophical perspectives that involve cultivating and integrating eco-politics into everyday urban life (Moore & Kosut, 2014).

UBK can also be viewed as escapism for city dwellers — some people take it up because they want to learn a new skill and be more self-sufficient; it is also an exciting hobby to immerse oneself in (Sampson, 2019). There is also something very "zen" about taking care of the bees, as urban beekeepers pointed out to me in interviews – you can't go to the hive while being stressed or agitated, making it a good way of "zoning out" after a hard day of intellectual work (Naumanis,E., personal communication, October 27, 2019), (Tiia, personal communication, November 8, 2019), (Sander, personal communication, November 4, 2019).

Bees like living in the city: it is warmer and there is a much larger variety of flowering plants available than in the often "mono-cropped" countryside. This fact has been pointed out by research and an interview with biologist and bee enthusiast PhD L.Puusepp from Tallinn University (Puusepp, L., personal communication, December 5, 2019). According to her analysis, origins from 25-30 different plant taxa are present in urban honey compared to the 13-14 taxa in rural honey. Urban bees also often produce more honey than rural bees, as the beekeepers also pointed out in interviews.

New York magazine suggested readers already ten years ago to "think of bees as your new pets (*The Everything Guide to Urban Honey - A Primer for Owning Your Own Bee Hive -- New York Magazine - Nymag*, n.d.). Until quite recently, most people never thought of honeybees as a species that "naturally" belonged in the city. "Unlike pigeons or cockroaches, bees don't spring to mind when we think of urban animals (Moore & Kosut, 2014)."

Many newcomers to beekeeping mistakenly see it as a reasonably easy hobby, when in reality, they have neither the knowledge nor the time for it (Schuetze & Karasz, 2019). Some experts offer concern that the rise in amateur beekeepers keeping hives on roofs and gardens is harming wild bees (Knapton, 2018, Stange et al., 2017, Geldmann & González-Varo, 2018). Conservationists argue there is a lack of distinction in public understanding between an agricultural problem and an urgent biodiversity issue.

Beekeeping can be a fascinating hobby, but should not be seen as a way of helping bees when done in areas where honey bees are already very abundant (Norfolk, 2018). There are many ways of contributing to urban beekeeping without becoming a beekeeper (which is certainly not suitable for all):

1. hosting beehives in a garden, park or greenspace;
2. "adopting" a hive or bees;
3. Volunteering in a beekeeping community (Benjamin & McCallum, 2011, pp. 81-88).

Hence, urban beekeeping, although a fine hobby, should be practised by those who are ready to commit, have enough training and can make sure that the bees have plenty of forage. For people who are not in the position to take up beekeeping by themselves, there are other ways for contributing and helping the urban bees.

3.4.1. Who are the urban beekeepers?

A distinction between urban and professional (rural) beekeepers can be seen about their attitude towards harvesting honey. While professional beekeepers see honey as the end goal of keeping bees and means for providing their livelihood, many urban beekeepers have expressed the feeling that their main goal is protecting the bees with honey being a nice added value to the process.

Urban beekeeping takes time, money, a long time to master the skill, and commitment. It also means that (at least in Estonia), the short summer months are busy with at least weekly hive checks, extracting honey, taking care of the bee colonies and fighting pests.

In England, the media has witnessed the emergence of the contemporary urban beekeeper and farmer, a demographically new breed quite different from the previous “beardos” (mainly older men who have kept bees for years) (Benjamin & McCallum, 2011, p. 51). While, for example, in New York and London, many young women have taken up the hobby, interviews with local urban beekeepers in Tallinn have shown that here, the majority of newcomers fall into the age category of 30/35+ men with IT background, as was suggested by Erki Naumanis from Tallinn Beekeepers Association (personal communication, October 27, 2019). This can probably be attributed to the fact that urban beekeeping takes resources (both financial and time) and commitment, meaning that it rarely suits (younger) people who haven't settled down yet.

In conclusion, it can be said that finding a suitable space for an apiary can be quite a conundrum, as some people are still quite wary about bees (especially parents of young children), being afraid of stings and swarming. However, educated beekeepers know that these risks can be quite well managed (e.g., by placing hives either on a rooftop or orientating it in a way that the bees don't cross the pathways of people; checking hives regularly for swarming). There is currently a gap in bringing together people who would like to potentially host a beehive (or more) in their garden and beekeepers who are looking for the best locations with plentiful forage.

From the interviews view local beekeepers in Tallinn, I learned that they also struggle with proving to potential consumers that urban honey is not polluted and is safe to eat. However, analysis has shown that urban honey is indeed clean. They are looking for ways of creating more value for urban honey and ways of engaging with the local communities (including restaurants and shops as potential resellers).

3.5. Approaches for increasing urban biodiversity and pollinator protection

I explored what the suggestions and tools for supporting biodiversity and the position of pollinators proposed by experts are. Firstly, I looked at the reports published by IPBES: The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services – an independent institution to strengthen the science-policy interface for biodiversity and ecosystem services. IPBES has suggested in their comprehensive report five main

interventions for policymakers in order to bring on change by tackling the drivers of the deterioration of nature and ecosystems:

1. incentives and capacity-building;
2. cross-sectoral cooperation;
3. pre-emptive action;
4. decision-making in the context of resilience and uncertainty;
5. environmental law and implementation (Watson et al., 2019).

Introducing these levers may require new resources which many countries have yet to integrate into their policies. The report (Watson et al., 2019) also states that urban key biodiversity areas should be protected by solutions like creating and maintaining green spaces and biodiversity-friendly water bodies, urban agriculture, rooftop gardens and expanded and accessible vegetation cover in existing urban and peri-urban areas and new developments.

Ecosystem approach and human stewardship

An integrated ecosystem approach has been proposed three objectives proposed by the Convention on Biological Diversity: economic prosperity, social well-being and environmental sustainability (Douglas & James, 2015, pp. 64-68).

An urban ecosystem, with various inputs and outputs to and from the global environment around the city and many internal feedback loops, relies on better *human stewardship* of natural resources and the urban environment. One of the principles of the ecosystem approach states that the objectives of land, water and living resources are a matter of societal choice**.** Another principle states that it should seek the appropriate balance between, and integration of, conservation and use of biological diversity and should involve all relevant sectors of society and scientific disciplines (Douglas & James, 2015, pp. 64-68).

Participation in environmental stewardship projects helps inner-city residents' sense of community, connection to place, and empowerment, as much as improving ecological health. Participation has also been associated with increased willingness to take action within one's neighbourhood and was more likely to become environmental stewards in their neighbourhood and yard after they participated in urban greening projects (Ryan, 2015).

These findings support my framework of applying the principles of placemaking in urban (greenspace) design as an essential factor in boosting the overall biodiversity level. It also emphasizes the importance of collective actions as part of participatory ecology in mainstreaming the environmental steward approach among the general public.

Effective greenspace system

An effectively functioning urban greenspace system can be established in almost all cities by tying together separate patches of the system. A network of corridor-connected large green patches remains the ideal framework for a metro area; however, this is nearly impossible to achieve in most urban areas (Forman, 2013, pp. 343-371). The *percentage* of greenspace, mainly trees, is positively associated with ecological performance (Taylor & Hochuli, 2015). In an ideal situation, urban planning should focus on also preserving large areas of habitats (> 50 ha) and a network of corridors between them**.**

According to Forman (2013, pp. 343-371), the three keys to a successful greenspace system, in order of importance, seem to be:

1. Maintain major species-source areas close to the all-built metro area.
2. Maintain an arrangement of urban greenspaces, green corridors, and tiny green spots that are accessible, e.g., within local urban wildlife.
3. Design UGS and corridors internally to enhance species survival and especially flows between them.

For a greenspace system to provide rich biodiversity across a metro area, it requires a continual “species rain" – a steady influx of species – from the surroundings.

A finer view of small patterns and processes is needed to understand urban habitats and biodiversity. Instead of only examining roads, parks, shopping centres, industrial areas, and so forth, we should “use the human eye" and look at key “hot spots" for species (e.g., an old mother tree, or rare wet spot) (Forman, 2013, pp. 343-371).

Lazy lawnmowers

Urban lawns, in both residential and public green spaces, are often being subject to frequent defoliation due to excessive mowing. Killing off weeds is another reason for lawns to suffer from poor biodiversity: “Weed-free means biodiversity-impoverished" (Forman, 2013, pp. 311-342). Positive effects of vegetation can be used to enhance species richness in those urban landscapes where extending the size of UGS is not an option. Such an approach could be complemented by biodiversity-friendly management (Forman, 2013, pp. 205-240).

A recent study showed that lawns mowed every three weeks had as much as 2,5 times more lawn flowers than the other frequencies (Lerman et al., 2018). The results highlight a “lazy lawnmower" approach to providing bee habitat. Mowing less frequently is practical, economical, and a timesaving alternative to lawn replacement or even planting pollinator gardens and offer an immediate solution for individual households to contribute to urban conservation (Lerman et al., 2018).

Meadows

Figure 5: Meadow from Manilaid. Credit: Vaido Otsar, www.wikimedia.org

Another study from France demonstrated that a reduction of mowing frequency also induces an impressive increase in plant community diversity that results in a switch from urban lawns to urban meadows (Chollet, 2018). Sowing wildflower seeds or merely altering mowing regimes can convert flower-poor grasslands on public and private lands to areas providing greater amounts of flowers that are attractive to pollinators (Stange et al., 2017), as well as increase the number of bumblebees and hoverflies manifold.

Flower-poor grasslands can thus be readily converted to flower-rich areas that are highly attractive to pollinators, providing a simple tool for pollinator conservation in urban areas (Blackmore & Goulson, 2014). Creating new semi-natural meadows is also proposed by many Estonian experts. Yet, after reading case studies about creating urban meadows (Ustav, 2017), it is evident that such an endeavour on a larger scale takes previous expertise in either biology or landscape design. The seeds have to be collected from the meadows or selected and ordered from abroad. The grasses and flowers can also be gathered and planted by hand. Thus, the venture is currently suitable only for the most committed enthusiasts.

3.6. Urban biodiversity activism in Estonia

Urban biodiversity has recently seen more limelight in Estonia as well: advocates for biodiversity have written about the importance of biodiversity to human wellbeing, as well as about the means for reducing the ecological footprint of urbanization (Magnus, Riin & Mäekivi, Nelly, 2018, Helm, A., 2018, 2019) urges everyone to make small steps in their surroundings to foster biodiversity - “everyone's nature conservation" (igaühe looduskaitse).

Helm suggests the following:

> *"We must bring back conditions suitable for biodiversity to every landscape, every city, every village. Each one of us can do it – every citizen, company, and local government, no need to wait for a decree or permit, for a plan or graphic. We must not expect that our nature-friendly activities should always be paid for, or that we should be applauded for it. We need to care, notice, know, and decide".*

Not everyone in Estonia is a fan of the idea of "letting weeds and hay" grow in public spaces (Raudvere, Rein, 2019). Creating public spaces following the principles of biodiversity is often met with contempt and lack of understanding, as landscape architect Karin Bachmann pointed out (Helm et al., personal communication, December 18, 2019). Although this suggestion is a noble one, knocking on people's conscious and innate will to "do the right thing", I am also a firm believer in nudging and incentivizing actions. Grass-roots initiatives often need a push in order to take them to the next level.

One of the most comprehensive guides on how to put the everyman's nature conservation into action, is published by the Stockholm Environment Institute Tallinn (SEI). SEI Tallinn has over the years published several books and articles with tips how to (Uustal, Meelis, 2013).

The Estonian Environmental Board has for two consecutive years (2019-2020) ran a campaign on biodiversity by publishing an illustrated guideline on how to make your garden more diverse. However, these actions have remained single episodes and have not been followed up by other supporting actions.

Figure 6: Everyman's nature protection. Credit: Estonian Environmental Board

Another tool for mainstreaming and popularizing nature conservation and biodiversity protection is citizen science. Citizen science (CS) refers to scientific projects that include the participation of volunteers (novices or experts) in some aspect of scientific projects. A CS project can be defined as a distinct, biodiversity recording scheme or volunteer survey, often with a specific management team and discrete goals and taxonomic or geographical focus (Chandler et al., 2017). Lately, CS has become increasingly popular in Europe,

including Estonia, providing scientists with an abundance of data and on the other hand offering people an excellent way of spending more time in nature and learning to appreciate the species richness around them.

Protecting urban biodiversity in Tallinn and Tartu

Within the last 25 years, 139 protected species have been registered in Tallinn that makes up 73% of relevant protected species in Estonia – an impressive result for a (*Euroopa Roheline Pealinn 2019*, n.d.). Preserving and increasing natural urban biodiversity is also stated as one on the main objectives in Tallinn Environment Strategy to 2030.

As the document states:

> "Natural diversity is the basis of a healthy and pleasant living environment. Higher biodiversity levels will ensure higher productivity and the stability of communities, and metaphorically better health for ecosystems, which is the basis of a valuable living environment through the services of the ecosystem. Therefore, *more efficient use of the city space* shall at least be ensured from the need to preserve natural diversity, while in the longer perspective opportunities shall be created to increase natural diversity in densely built-up areas" (*Tallinn Environment Strategy to 2030*, 2011).

Tallinn Biodiversity Action Plan (*Tallinn Biodiversity Action Plan for 2016-2020*, 2015) has also set focus on preserving and increasing biodiversity – an objective derived from the Tallinn Environment Strategy.

From the interview with M.Uustal, I learned that the main reasons hindering biodiversity and pollinator protection in Tallinn stem from the regulating acts (maximum length of grass being 15 cm) and management principles (mainly, mowing frequency) of greenspaces. For municipal greenspace management changing these principles is especially complicated, as the City has various subcontractors maintaining these greenspaces and making an exception and communicating these to the various partners can be arduous (Uustal, M., personal communication, February 10, 2020).

Critics of the City's lack of action point out that Tallinn does not invest enough into integrating green areas into new residential areas and focuses more on building new motorways than bicycle lanes (Karro-Kalberg, 2019).

Compared to Tallinn, the City of Tartu is taking a much auspicious and bold approach: *everyone's ecology* is an integral part of the programme for the European Capital of Culture 2024. The programme includes activities such as focusing on the sustainable development of Toomemägi and banks of Emajõgi, concentrating on sustainability, placemaking and reconnecting the population of Tartu with the nature of the town (*Tartu 2024 - European Capital of Culture*, n.d.). Environment, generations and community also constitute the main three themes in Tartu's cultural strategy KU30 (*Kultuuristrateegia 2030*, n.d.).

Therefore, it would only be fair to compliment Tartu in taking on the leader position in promoting urban biodiversity and wholeheartedly contributing to building a more sustainable, liveable and lovable city.

3.7. Rethinking urbanization

The United Nations Report, "The Weight of Cities", predicts that over the next 30 years, an additional 2.4 billion people are likely to be added to the global urban population, meaning a shift from 54 per cent of the population living in cities in 2015 to 66 per cent in 2050 (*IRP (2018). The Weight of Cities: Resource Requirements of Future Urbanization*, 2018). In Europe, the percentage of green space has been calculated to vary from 2 to 46% among cities. Thus, urban areas offer a vast opportunity for biodiversity conservation.

Figure 7: Birmingham, UK's first biophilic city. Credit: Sharon VanderKaaj. Source: www.flickr.com

Charming Anthropocene and biophilic cities

Sociologist Holly Jean Buck (2015) from Cornell University proposes a concept of a Charming Anthropocene. Instead of the majority of rather gloomy narratives and predictions of the future of the Anthropocene that we currently live in: a reawakened sense of wonder, an ethic of care, and aesthetic and cultural production provoking cultural and political change.

Another possible approach proposed by Buck (2015) is the concept of a biophilic city, which emerges from the idea that humans have an innate affiliation with and evolutionary need for contact with nature. The aesthetic and cultural elements of such cities include green roofing, community forests and orchards, edible landscaping, living courtyards, green utility corridors, pocket parks, vertical gardens, bird-friendly buildings, and so on, which make visible the ecosystems within, and blend art and craft on the part of citizens to form relationships. Buck (2015) explains that biophilic cities mimic and incorporate natural forms, but also imply an expanded ethic, activities, attitudes, knowledge, institutions, and governance in short, conviviality.

The United Nations suggests that a liveable Anthropocene could be created around movements focused on the right to enchanting cities and transforming them through politics, art, and craft not into expensively designed green enclaves but into places where encounters happen (Environment, 2019).

Most of these scenarios and notions have much in common with the framework of placemaking theory: zooming in on local neighbourhoods and collectively reinventing our public realm and spaces in the city, paying attention to the cultural and social identity of its dwellers – human and nonhuman.

Ecological literacy and systems way of life

Systems theorist and deep ecologist Fritjof Capra and natural scientist Pier Luigi Luisi suggest in their comprehensive book "The systems view of life" (2014, pp. 353-356) that the first step in designing a human community in such a way that its activities do not interfere with nature's inherent ability to sustain life, is to become *ecoliterate* – understand how nature sustains life. The systems view of life proves a framework for the link between ecological and human communities. Both are living systems exhibiting common principles of organisation and result in new forms of order and structures. Thus, we can and must learn from ecosystems how to live sustainably.

Based on a systemic understanding of ecosystems, the following principles of ecology can be used as guidelines to build sustainable human communities:

- Interdependence: all members of the ecological community are interconnected in a vast network of nonlinear relationships;
- Cyclical nature of ecological processes;
- Partnership being an essential characteristic of sustainable communities.

Ecosystems are sustained by cooperation – in a nutshell; nature sustains life by creating and nurturing communities. Thus the way to sustain life is to build and nurture community (Capra & Luisi, 2014, pp. 341-361).

Civic Ecology and humanising the city

In his eye-opening book "From Neighbourhood to Bioregion: The City as a Living System" designer J.Thackara (2018) talks about humanising the city – making it healthy for people – and therefore making it habitable for all of life, not just human life. This means thinking of the city as a local living economy, not as a machine, and embracing biodiversity, and local economic activity, as better measures of a city's health than the amount of money that flows through it.

Thackara (2018) notes that the notion of the city as a living system has also generated the growth of ecological urbanism or civic ecology. These practices study how to help living organisms and their environment thrive together. They enrich city design with the insights of ecology, botany, climatology, hydrology, geology, and geography.

Nature and the aesthetics of joy

In her very engaging book "Joyful: the surprising power of ordinary things to create extraordinary happiness" Lee (2018) digs deep behind the reasons how tangible things create an intangible feeling of joy. How is the notion of joy connected to the topic of

biodiversity? Lee (2018) refers to the author of the book “The Moth Snowstorm: Nature and Joy“, British environmentalist Michael McCarthy who says that people need more emotional reasons for protecting nature and biodiversity than the obvious „it's a good thing to do“. McCarthy (2016) proposes the concept of (re)introducing the joy found in nature which many people, even generations, have lost over time, especially in cities.

Lee also describes visiting world-famous landscape architect Piet Oudolf, an advocate for “wilder” (yet, still curated) and more diverse garden aesthetics: “Oudolf's use of native perennials has inspired thousands of home gardeners to re-create local plant communities that benefit insect populations. In the aesthetic pleasure of wilderness, they are cultivating a new kind of environmentalism, one rooted not in obligation to do what's right but in *joy*” (Lee, 2018).

To conclude, the brighter future of cities includes taking on an approach of creating biophilic, humanised (and, thus, also nonhumanised), wilder places and letting go of the outdated concept of considering the urban environment as a “concrete jungle”.

3.8. Inspiring cases

Before proposing my solution, I also looked into existing cases from different cities all over the world that have tackled the topic of designing for pollinators as well as people and creating enchanting places as well as stable urban ecosystems.

“Bee hotels" in Utrecht

Recently, the City of Utrecht in Netherlands turned 300 bus shelters into bee sanctuaries (*A Dutch City Is Turning Bus Shelters into Bee Sanctuaries*, 2019).

Figure 8: Utrecht bus stops with green roofs. Source: commons.wikimedia.org

More than 300 bus shelters have been transformed into bee-friendly green hubs to support biodiversity in the city. Grass and wildflowers have been planted on the roofs providing a forage for bees and other insects. The green roofs also help capture fine dust, store

rainwater and provide cooling for the heat. Studies are underway to determine their impact on biodiversity. The city of Utrecht also plans to have the largest bee hotel in the world to attract bees to help biodiversity.

Although the bee hotels might not have a strong effect on biodiversity, it is unquestionably a good PR-move for the city and also harbours potential to draw people's attention towards pollinator protection.

Minnesota paying people to create pollinator-friendly lawns

The State of Minnesota in midwestern U.S. will pay its residents to create bee friendly lawns (*Minnesota Will Pay Residents to Create Bee Friendly Lawns*, 2019). To protect bees, the state has set aside $900,000 dollars for bee-friendly spaces. From that sum, the state government will pay the gardening bill for residents who are willing to turn their lawn into bee-friendly spaces, by planting flowers known to attract bees, like creeping thyme, self-heal and dutch white clover.

This can be seen as an incentivizing action by decision-makers also suggested by IPBES (Watson et al., 2019) as means for launching local biodiversity actions on a larger scale.

Pollinator Pathway in Seattle

Pollinator Pathway ™ (Pollinator Pathway, n.d.) is designer Sarah Bergmann's interdisciplinary design project in Seattle, Washington: it is a mile long project that connects Seattle University's campus with a small woods called Nora's Woods.

With the project, Bergmann wanted to express a difference between urban ecology, thinking of the city as an ecosystem, and designing it in a way that cities can help support global ecology (outside cities). According to her, this means designing for density: connecting biological life and supporting density but *without adding to urban sprawl.* The pathway only uses underused space (in this case, planting strips owned by the city) and a high number of native plants.

I contacted Sarah Bergmann in order to explore more about the project and about a branded toolkit which she created for stakeholders in order to ensure that all possible participants in the project would have a clear understanding about the project. From her e-mail, it also became evident that many people saw the project as an attempt to “save the bees", yet Bergman's main reason for taking up the pathway was to design an urban greenspace without contributing to the urban sprawl (S. Bergman, personal communication, November 15, 2019).

The Pollinator Pathway is a fine example of a biodiversity and pollinator project on a city scale but it also proves that taking on such an endeavour on her own (Bergman spent years to talking to all property owners in the area convincing them about the importance of the project) is not a feasible option on the long run. It makes sense to look into co-managing such projects and sharing the workload and responsibilities.

Insect Highway (Putukaväil) in Tallinn

Tallinn has also taken on a project contributing to pollinator protection: a 10.6 km long strip of land of former railway and high voltage transmission cable is being transformed into a green corridor (*Augmented Urbans | Tallinn*, n.d.):

> "The corridor starts from Astangu through Kadaka, Veskimetsa, Mustjõe, Merimetsa to Pelgulinna Kopli freight station at Telliskivi street passing through old industrial areas and crossing busy roads, but it also connects different forests, meadows, brownfields and garden districts teeming with wildlife. More than half of the strip has been recently turned into a mixed-use pedestrian and bicycle path. The last 2.5 kilometres closest to the city centre constitute the Augmented Urbans Tallinn Local Action site called Putukaväil: „Insect Highway". The aim of the project is to enhance the functionality of the ecological green corridor and keep its ecological values, parallel to the development in the urban environment."

I met up with Anu Leisner, project manager for the Insect Highway report, to discuss the ongoing project (A. Leisner, personal communication, December 6, 2019). I learned that getting all different stakeholder related to managing the green areas on the same page about the maintenance schedule (e.g., how often to mow the area) can be a real hassle. It also became evident that raising the awareness on pollinator protection and maintaining a suitable habitat for them (mowing certain areas only once or twice a year) needs a lot more explaining, as some people do not agree with the aesthetic of uncut grass. "Unkempt" greenery can also trigger fear of insects such as mosquitos and ticks. However, the majority of the local people were positively engaged by the project.

In order to the assess the abundance of pollinators (mainly bees and butterflies) in the area, a group of scientists carried out a study in summer 2019 within the last 3 km of the project space. Each section of the Pollinator Highway was assessed based on three characteristics: 1) diversity of pollinators, 2) human impact, and 3) abundance and diversity of plants used for forage. None of the sections received the highest possible grade (Sõber *et al.,* 2019).

Doing means planting and sowing nectarous plant species; creating nests and habitats for the pollinators (e.g. leaving branches on the ground). Not doing consists of mowing less (once or twice per year) and using the mosaic method (part of the area mowed in one year, others next year), in order to create greater plant diversity; leaving fallen leaves and branches on the ground for bumblebee nests and butterflies to winter. It also includes leaving trees and shrubs uncut to offer the pollinators refuge from the wind and create a better micro-climate and food source for caterpillars. Naturally, it also means ending the use of pesticides.

It was also suggested that *ca* 2/3 of the area should be covered by semi-natural meadows offering forage for bees and butterflies. The seed mix used for creating the meadows should consist of Estonian meadow plant species or well-known cultivated plants. Bushes and shrubs flowering in spring should be planting, focusing on areas where the natural plant life is scarce.

Putukaväil is Tallinn's first intent on creating a more pollinator-friendly environment. I hope that this will be a good litmus test for testing out the guidelines and principles for managing greenspaces by embracing biodiversity and the needs of pollinators.

Project Melliferopolis

Project Melliferopolis was launched in Helsinki within the framework of *Biofilia – Base for Biological Arts* at Aalto University in 2012. It was initiated by Austrian artist, researcher and urban beekeeper Christina Stadlbauer and independent curator and artist Ulla Taipale (*www.melliforopolis.net*, 2018).

The project mixes urban beekeeping meets and art experimenting with new ways of understanding bees, beekeeping and the ecology of a beehive, as well as other urban insect pollinators. It aims to create shared spaces for human-insect cultures and facilities encounters through artistic installations in public spaces (Stadlbauer & Taipale, 2018). The project has designed a new type of hives (the hexa-hive) and uses pollinator-friendly flowering patches that enhance the growth of surrounding vegetation and the well-being of its citizens, as well as increasing the understanding of the importance of pollinators in ecosystems.

This project is an interesting example on combining pollinator and biodiversity issues with the field of art and design while contributing to placemaking in the urban environment.

Greenmeter

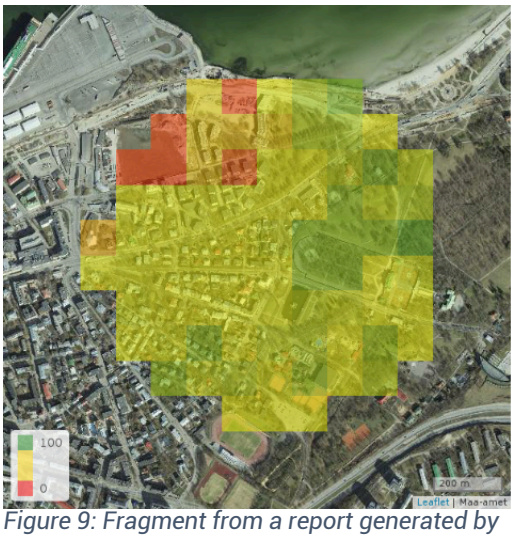

Figure 9: Fragment from a report generated by www.rohemeeter.ee for the author

In April 2020, the Landscape Biodiversity Group together with macroecology workgroup, led by professor Meelis Pärtel and senior researcher A.Helm from University of Tartu, published an application called *Greenmeter* (Rohemeeter) that helps to assess the natural diversity of Estonian landscapes.

The application algorithm is based on the analysis of more than 70 map layers, assesses the biodiversity of a selected area and gives suggestions on how to protect and increase biodiversity (*Rohemeeter - Maastike Elurikkuse Hindaja*, n.d.).

In order to use the Greenmeter, the user has to select a point on the map, after which Greenmeter calculates how good the selected location within a radius of 500 meters is for biodiversity. In addition, information on the current situation and recommendations on how to improve the situation are given. The Greenmeter therefore helps to make better decisions when designing a yard or public space (*Tartu ülikooli teadlaste loodud rakendus annab soovitusi Eesti elurikkuse hoidmiseks*, 2020).

I applaud the project – besides providing valuable analysis, it also offers tips and guides for further actions, and is written beautifully and with relatable tone of voice. What I was missing, were ways to take the suggestions into the next phase: a proper action-plan with more specific guidelines. Like many other people, I am still a novice in gardening and need more help in making my first steps in such an attempt.

To sum up this chapter, what I gathered, was that a recurring theme in many of the projects was collaboration and co-creation with the local communities and a common goal of building a better, more nature-centred environment for urbanites: be it people, or in many cases, also pollinators. The creators behind these ventures were not afraid to decentre from the humanist centre point and invite other agencies into play but also add versatility and curiosity into the urban landscape.

4. Biodiversity and pollinators: a systems analysis

According to PSE, in the systems analysis phase, the designer builds on the holistic understanding gained from the previous synthesis phase to expose the deeper structures of the system and the relationships between elements and subsystems and moves on to abstracting the relationships in the system. The factors within the system include the products with its functional, aesthetic, social, emotional, and symbolic aspects; the services, the users involved in the system; and the physical, social, and cultural contexts surrounding the system (Forlizzi, 2013).

Analysing the insight collected from the previous stages, it became evident that in order to design a sustainable, pollinator-friendly place and home for human and nonhuman people, it is vital to get past the distinction between urban and rural divide. The younger generation already feels increasingly detached from nature (Ossola & Niemelä, 2018, p. 4), yet for many people (but also pollinators), the urban landscape and is the only kind of environment they know. We must accept that cities will not stop growing and that the clear distinction between what is considered cultured or wild is gradually fading.

As "true wilderness" is diminishing, we must protect its counterpart within cities, together with the habitats, be it humans, plants, insects or animals, within its sprawling borders (Douglas & James, 2015). Thus, instead of an urban-rural divide, we should focus on "a new urban", or biophilic cities (Buck, 2015), or humanising cities, a term coined by J.Thackara (2018).

Building a resilient home, but not exclusively for humans

As was unravelled from research, people should take *into account*, not *for granted* the ecosystem services provided by nature (Taylor & Hochuli, 2015). Research also pointed out (Ossola & Niemelä, 2018, pp. 36-48) that pollinators act as valuable contributors to ecosystem services by pollinating plants but also on the cultural and recreational level, also that pollinators act as a good proxy for assessing the biodiversity of an area (Stange et al., 2017, Sõber et al., 2019).

Pollinators (and other insects, as well as birds and animals) also need forage and moreover a habitat, a *home* – a place, in a similar manner as people do. While creating our homes, our places in the city, we ought to also design a home for other species, not only our human counterparts. This idea has also been proposed by world-famous designers (Thackara, 2018) as well as Estonian biologists (Sepp, 2019) as one possible future, as the urban-rural divide is dissolving.

This approach is also supported by posthumanist thinkers who emphasise the agency and responsiveness of nonhuman actors (such as, in this case, pollinators and other nonhuman urban species) (Carranza, 2018). Such a change in paradigm can produce more ethical relations (e.g., services) with the environment and nonhuman life forms. People are only starting to recognise the value of pollinators as the providers of valuable ecosystem

services but have yet really incorporated the protection of other urban lifeforms into urban design.

This concept of a shared place and home between humans and other urban species (in this case pollinators) should become the new reality: a conspicuous activity for all city dwellers. As Manzini (2015, p. 191 noted, while designing for social innovation, we have to take into account the dimension of placemaking : the existence of a multiplicity and variety of places is a precondition of a more resilient natural, social, and production system.

“We must all become Earth Stewards", as designers from the Cumulus Think Tank suggested (Tischner et al., 2015), and being a good steward of nature means ensuring that for us to continue enjoying the services we must consider pollinators as equal objects whilst designing our cities.

Adopting the aesthetic of diversity

As the biodiverse areas around the world are shrinking, it is about time to surpass the time of “green concrete” and the “blandscaping” trend (as pointed out earlier in thesis Chapter 3.2. (Connop, 2018,Kaplinski, 2019). Our back yards, parks and roadsides are currently lacking flowers, life, and diversity. People should be encouraged to create gardens and other greenspaces that don't necessarily resemble that of their neighbours. Such greenspaces providing a diverse plant life also fosters insect life (Forman, 2013, pp 343-371) and the overall wellbeing of people is improved by the presence of urban animals and pets (Taylor & Hochuli, 2015) there.

This shift towards a new environment aesthetics means also educating people and helping them to become more ecoliterate (Capra & Luisi, 2014, pp. 353-356) about the fact that a diverse garden doesn't mean excessive upkeep, rather the opposite. A touch of wilderness (*a la* Piet Oudolf) can be beautiful as well beneficial to nature (Lee, 2018).

UGS as an ecosystem

An important aspect about designing a biodiverse greenspace, is keeping in mind that the main goal is to look at the space as an ecosystem and zoom into what components does it need to be effective in that sense. For example, sowing the seeds of local meadow plants will not create an abundant field of flowers that could compare to the outcome from the annual summer flower seed mixes sold in most gardening shops, but it is by far a more sustainable option, as the resulting plant life will help to create a stable and sustainable ecosystem that will support insects, birds and animals for many years while the beautiful flowers from the imported seed mix will only last for one summer (M. Meriste, personal communication, March 23, 2020) and will not survive the year.

At the same time, a rich and exotic flower garden can also be extremely biodiverse if the plants are selected knowingly, and the whole green space follows the principles of biodiversity. Therefore, it is vital to carry in mind the importance of a systemic approach to creating a sustainable and biodiverse greenspace. Evidently, the majority of people doesn't possess this kind of know-how, meaning that expert guidance is needed in helping people, communities and the local government in creating and managing such environments.

Harnessing the power of cross-sectoral cooperation and incentivizing

This suggestion is mainly based on the IPBES guidelines (Watson et al., 2019) that in order to stop the decline in nature, we must focus on incentivising such actions, use cross-sectoral cooperation, preventive action (act before the situation becomes too dire) and change laws and regulations if necessary (Watson et al., 2019).

Therefore, I consider the City of Tallinn as a policymaker, an important stakeholder and partner in this action to support citizens in the joint attempt to make Tallinn more biodiverse. Cross-cultural cooperation should also engage ecologists and biologists to keep the initiative on the right track from the ecological perspective, provide guidance and curation. The term *participatory placemaking* can be used while talking about the cross-cooperation and co-creation taking place within the solution space.

If the local government is willing to invest in granting subsidies for people (and communities) creating more biodiverse habitats, in return, it will gain an overall increase in biodiversity. There are already examples from other countries, where the local authorities have tried this kind of incentivising: for example, last year Minnesota state declared an endangered bumblebee the state bee and reserved $900 000 for residents to create bee-friendly lawns (*Minnesota Will Pay Residents to Create Bee Friendly Lawns*, 2019). The City of Seattle has also recognized the work done on the Pollinator Pathway by designer S.Bergmann who has been nominated as one of the most important people of the city.

While talking about incentivising, it is also important to recognize the importance of bringing *joy* back into the greenspaces, something that has got lost during the last decades of blandscaping and green deserts. Harnessing the power of joy is cultivated by designer I.F.Lee (2018) and environmentalist M.McCarthy (2016). We all know that protecting the nature is expected from us, but people need more (often emotional) reasons for doing. Joy is a powerful incentive and has already an innate connection to nature, so it is for us help people to rediscover it.

Linking greenspaces

In Chapter 3.5. I established that in case of biodiversity, a large area is better than a small one and that creating large areas of habitats (> 50 ha) and a network of corridors between them, cities may even develop into refuges for species conservation (Forman, 2013, pp. 343-371). Green networks are especially important in providing connectivity for species or people (Forman, 2013), that is why connecting UGSs is a critical aspect of this design concept.

If we zoom in, then we can see that small neighbourhood corridors such as lines of street trees, front and back yards, side-boundary hedges and fences, are often conspicuous and of considerable ecological importance (Forman, 2013, pp 343-371). Thus, linking such areas help to grow the green network, if the individual UGS otherwise lacks size. As was already established, that plant diversity can be extremely high on a house property (Forman, 2013, pp. 205-240; pp. 343-371), making the idea of connecting various household UGSs rather promising.

Using these building block as my design drivers, I entered the next phase – designing my solution.

5. Designing BioTa: a biodiversity platform

According to PSE, the systems redesign phase the designer creates plans and solutions for putting a new and improved system in place. A holistic view of the system is created, and through this activity, designers strive to understand how the prototype solutions they create will „set off" the existing system (Forlizzi, 2013).

As I did not have an existing to redesign, my solution is based on an iterative process relying upon synthesising and analysing the previous insight, user input and case studies as described in the previous chapters, compared with my own "what if" and "how might we" scenarios.

Current situation

Tallinn (and many other cities all over the world) is currently lacking a unified system for increasing biodiversity, although it has recognised the importance of pollinator protection in action-plans. Although the city is visibly "green", the greenness comes mainly from pre-existing parks, lawns, roadsides and gardens and the current legislation does not support management practices that support biodiversity. There is one promising ongoing project focused on pollinator protection – the Insect Highway – but this action centres only on one specific area.

The city takes an interest in promoting community garden movement and has a system for allocating grants for housing associations to make their yards greener, but these actions are not combined under one umbrella and don't have the biodiversity or pollinator "clause" integrated into them. There are also many residential areas in the city with private gardens, as well as roadsides and parks currently with green but empty lawns harbouring a great potential for boosting biodiversity and focusing more on the needs of pollinators.

Estonia is losing one of its most significant natural resources – meadows teeming with wildlife – yet there is enough greenspace in the city to (re)introduce at least patches of these meadows into the urban environment in order to create more stable ecosystems than a lawn with maximum height of 15 cm. It seems that there is potential for a combining many of the actors mentioned above under one roof, or better yet – on a shared platform.

Based on the previous work, I propose a following design concept:

BioTa

BioTa[*] is a platform that connects urban dwellers (individuals and communities), relevant city administration officials and subcontractors (responsible for mowing and maintaining green spaces), as well as experts (with a background in ecology and biology) towards a shared goal of supporting and increasing biodiversity and protecting pollinators in urban greenspaces.

[*] *Biota - the animal and plant life of a particular region, habitat, or geological period*

BioTa relies upon a deep-rooted appreciation and understanding of nature. It encourages its members to follow the principles of biodiversity in order to create a sustainable home for people and other urban species, with an emphasis on pollinator agency and protection.

By educating, guiding and subsidizing its users and offering automated personalized plans for biodiversity management, the platform aims to grow the network of biodiverse greenspaces in the City and turn the “green deserts" prevailing in urban gardens and parks into more stable and sustainable ecosystems. BioTa promotes the cultivation of mainly local species and re-introducing semi-natural habitats (such as meadows) into the urban environment.

The platform combines value-added service with products gathered under a joint, branded umbrella, following the principle that „customers do not want standalone products, they want solutions" (Arico, 2016).BioTa provides easy on-boarding for people or communities who don't have prior experience in gardening or ecology by using intelligent recommendations, tips, suggestions, personalized greenspace management plans, workshops and other social features in order to make creating biodiverse greenspaces smoother and more accessible.

Incentivizing from the City provides with capital to start acquiring plants or seeds that offer forage and a habitat for pollinators and other urban species but also take into account the personal preferences of BioTa greenskeepers. BioTa makes it easy to combine already existing plants with new, preferably local additions, for continuous bloom throughout the growing season from spring to fall.

Co-managing the platform and future biodiversity initiatives give its members an option to partake in decision-making and choose the level of involvement they prefer.

5.1. Main features

The systems architecture of BioTa consists of the following layers: databases (internal and external) and algorithms; applications, users and value creation. A schematic map of BioTa is included in Appendix No 1.

Data layer

The first layer of BioTa consists of both internal and external databases. BioTa harvests data from existing databases, such as eElurikkus, EELIS and Greenmeter, retaining information on biodiversity, protected species, plant and animal lists (with geotags) and citizen science, as well as municipal databases containing relevant financial and legal information. It also uses maps (including soil maps) from Geoportal.

Data from these databases enables BioTa to create a comprehensive database on plant, insect and animal species as well as list matching it with the location of protected species, in order for BioTa members to contribute to pollinator and animal conservation. Essential data input comes from BioTa users (address, size, property type, soil type, existing plants and species, sunlight direction). It also collects data from citizen science.

BioTa also allow the City to collect applications for and grant subsidies and connects BioTa users with trusted vendors making purchasing plants and seeds using the subsidy. It is also connected to external identifier apps allowing users to upload data from such applications into the platform.

By analysing and comparing this data and combining it with regular assessments carried out in the UGS, BioTa can provide experts and scientists with valuable new knowledge, for example, create a comprehensive map on biodiversity in the area, detect changes and provide data for predictions.

Algorithm and plant recommendation engine

BioTa algorithm uses the data layer to create personal plans for UGS management: the algorithm collects and analyses details about UGS entered by users and external databases (including suggestions from experts) in order to create personalised management plans.

It also features a plant recommendation engine that analyses the list of plants already growing in the UGS, personal preferences entered by the user, list of plants from the EELIS and eElurikkus databases and expert input. It points out possible gaps in the flowering timeline. It recommends additional plants to be used (based on the flowering calendar) that would support a continuous flowering time in the UGS for pollinators present (or favoured by the user) in the area.

Application layer

The application layer is an abstraction layer on top of the database layer that allows users to access BioTa functions and services through respective user interfaces.

BioTa's most important applications are as follows:

- Adding and editing greenspaces into the system and an interactive map of the BioTa green network. The application makes also supports sending invites to owners of new greenspaces and linking together neighbouring areas.
- Receive personalised suggestion for a specific UGS on how to maintain urban biodiversity principles with step-to-step guidance.
- Use a flowering calendar application in order to support pollinators by including new plants that would ensure ample forage from early spring to fall.
- Connecting and sharing with other users using BioTa's social features.
- Applying, processing and granting subsidies for new members.
- Using the subsidies to purchase seeds and plants from certified vendors connected to BioTa listed in the personalised plans and flowering calendar.
- Plan and carry out a yearly assessment on UGSs.
- Citizen science and UGS data collection and analysis for scientific purposes, composing predictions and planning. Based on the information, accurate biodiversity map of the City is created.

A more detailed view of the inputs and outputs of the applications for each user group can be seen from the schematic map (Appendix 1).

5.2. Value creation

Creating and delivering value to the customers through BioTa's unique applications and features is the underlying aim of designing the platform. The value created by BioTa could be measured by perceived user value. The monetisation of the services offered by BioTa is not discussed here, as BioTa is not designed to be a business opportunity, rather than a public good.
Value to the users is created through the following primary activities:

Growing in volume

BioTa helps to grow the number of UGS contributing to biodiversity and pollinator protection, thus increasing the overall biodiversity index in the area, making it an important goal for the City.
The effect on biodiversity increases by *volume*, therefore enabling users to link their UGS to neighbouring areas, in an essential feature for creating a successful and organically growing biodiverse patch-corridor matrix, potential green corridors and networks. This effect can be multiplied especially adding large-sized public greenspaces, private gardens and unused greenspaces (such as roadsides) into BioTa.

Co-management and co-creation

A green network can grow only when the membership grows. Interlinking greenspaces and co-creating a system of green networks have a vital spin-off result: developing stronger social ties and interactions between different stakeholders. Through BioTa, likeminded people have a channel to engage between themselves but also with the local municipality and experts. Users can decide by themselves their level of involvement in co-managing the platform, but in general, cooperation and co-management constitute the “default” relationship and management form in BioTa.

Incentivising

BioTa uses incentivising from the local government as a tool for attracting new members to the initiative and help them to kick-starting biodiversity actions. This is done by granting new members a subsidy allocated from the municipal budget for supporting biodiversity and pollinators. The extent of the subsidy is not specified in the thesis as it is a matter of further discussion. However, the fact remains that motivating users financially as well as morally, has a strong effect on the outcome.

Incentivising doesn't only come in the form of financial aid. It is also propelled by a shared feeling of accomplishment that comes with supporting pollinators and biodiversity actions – everyman's contribution to “saving the environment and saving the beep” (*to be clear, this is not intended as an ironical statement*). By changing the current management principles of UGS, we can create richer, more abundant greenspaces resurrecting the lost component of joy has been erased by the blandscaped green deserts prevailing in many cities. Joy is a powerful feeling and incentive that should not be underestimated.

Encouraging citizen science activities is another incentivising factor ensuring people to feel that their actions and impact is valued and that they can contribute to science even without being a scientist. Citizen science combined with education on biodiversity is also an effective and pleasant tool for introducing children to nature protection, learning about

different animal, plant and bird species and understanding the importance of pollinators in the urban ecosystem.

Servitisation

Another unique value of BioTa is focusing on re-introducing semi-natural meadows into the urban environment. As these meadows are home for an abundance of species, BioTa also suggests and helps users to turn roadsides, parts of parks or in case of individual users, a patch or part of their lawn (or an old flower border) into an urban meadow. This is supported by offering natural meadow seed mixes collected in Estonia carrying the BioTa brand helping to create a stable ecosystem instead of sowing annual flower seeds that are not a sustainable option in the long run. The seed mixes consist of Estonian meadow species or well-known cultivated plants in order to attract butterflies and provide nectarous plants for bees and can be purchased through dedicated vendors.

Focusing on pollinators

As one of the main goals of the thesis was to help the pollinators to be positioned as agents on the urban environment scene, all different actions of BioTa aim to strengthen the connection between people and pollinators by offering a more bio-centric approach to urban greenspace design. The needs of pollinators have been included in the BioTa algorithm and suggestions as well as tips and guidance provided by BioTa resources.

Abundant biodiversity data

By collecting data entered by users (data on UGS and citizen science) and regular assessments of the UGSs, BioTa provides experts (and other members) with an abundance of data on the biodiversity level of the City. This data can be used to run prediction models and contribute to green infrastructure planning. It can also be used to create a comprehensive Tallinn biodiversity map – a feature that currently doesn't exist.

Personalisation

Personalisation is nowadays a “must-have” in most modern services and service-product combination. BioTa offers personalisation in the form of personalised greenspace management plans based on the location (map) and data entered by the users (this will be discussed in more detail later in Chapter 5.1.). For example, two gardens of the same size can have very different natural properties (e.g. soil type, sunlight direction, existing vegetation) and therefore also need different approaches for supporting life.

5.2.1. BioTa service ecology

The Product Service Ecology (PSE) is an ecological system that takes a systems approach to describe and understand the dynamic relationships between people, products, social activities, and the context that surrounds a system (Forlizzi, 2013).

A schematic diagram of a PSE can be used to show products, stakeholders, the built and social environment, and the social and cultural context of use surrounding a product. It can

be either used to focus on minute details (such as individual product features), or broader issues such as the social context surrounding a system.

In this case, I chose the diagram (Fig 16) to illustrate the shift in focus from people as the main benefactors to pollinators. The map also shows how main stakeholders interact and what are the services or products rendered by each user group.

The different coloured layers of the map illustrate the effect of the stakeholders and their action to pollinators – the closer to the centre, the more consequences the stakeholders and their action have on the pollinators.

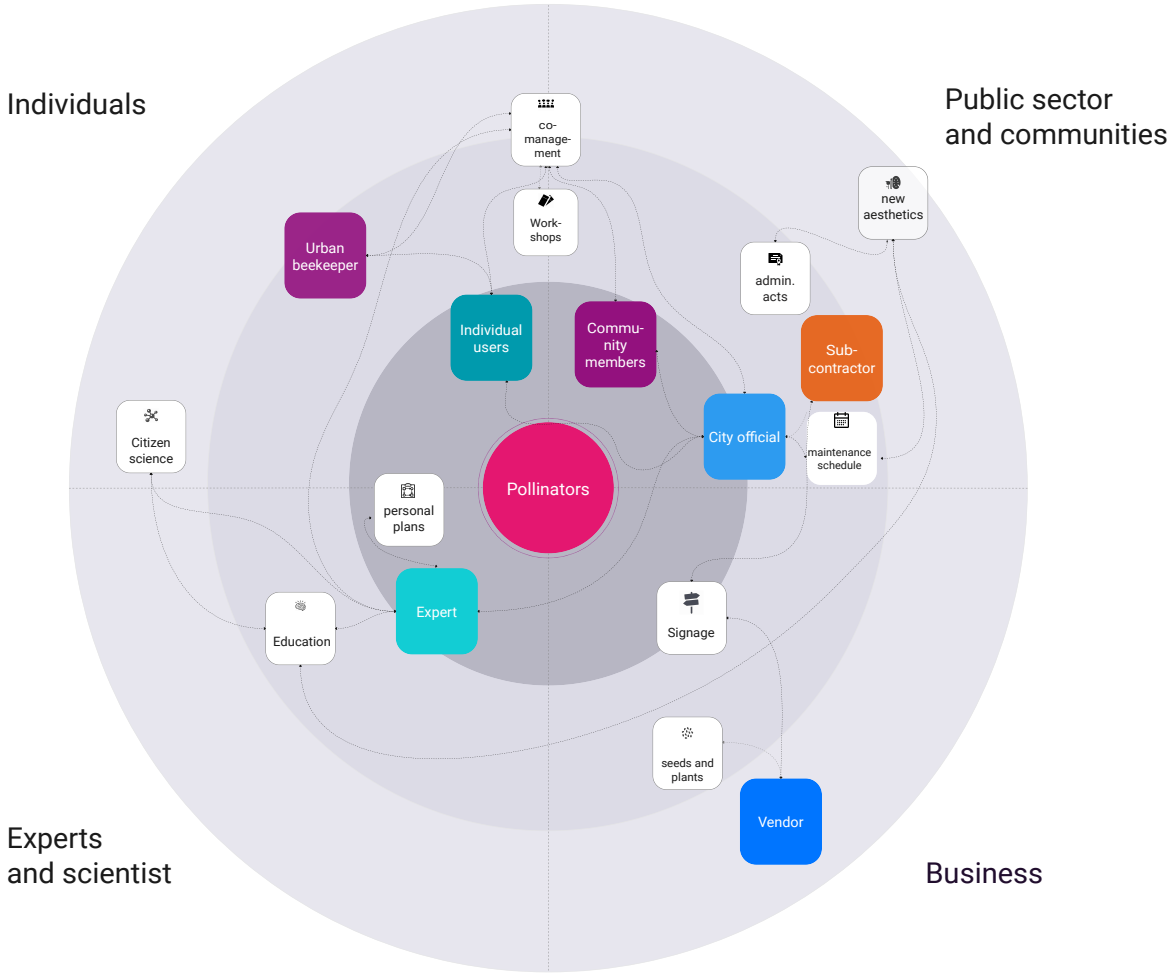

Figure 10: BioTa service ecology map

Although the solution aims to assign the pollinators to the central role, the duties of humans as co-agents should be acknowledged as well. After all, they carry a dual role: they are the consumers of the service system but must also represent the interests of the pollinators, as it is the decision of human agents that affect the greenspaces and thus also the pollinators.

5.3. Collaborative encounters in BioTa

In his book "Design, when everybody designs", designer E.Manzini (2015, pp. 93-118) proposes that each service can be defined as an interaction between people (and between people, things, and places), targeted to produce value and determines service encounters as being of collaborative nature. Manzini notes that in modern society, people have been de-skilled in practising cooperation and are only now le-learning this skill. Community gardens are a good example of this, as together, people in the neighbourhood can grow a lot more than individually on their windowsills or in small gardens.

The community garden example applies in case of BioTa as well: people can only contribute so much to biodiversity if it's a singular initiative, but by sharing the effort (and ideal), and connecting the diverse green spaces, a lot more can be achieved. This means that social ties can be strengthened between individuals and neighbourhoods but also between people and city or district administration and experts-scientists.

Collaborative encounters are characterized by four components: collaborative involvement, social tie strength and relational intensity that can be illustrated with the help of two maps: participant involvement (PI) map and interaction quality (IQ) map.

The first map (Fig 17) illustrates the interaction quality field of the encounters between participants and the quality of their social ties. It also shows a scale from "light" to "heavy" contribution in time and involvement.

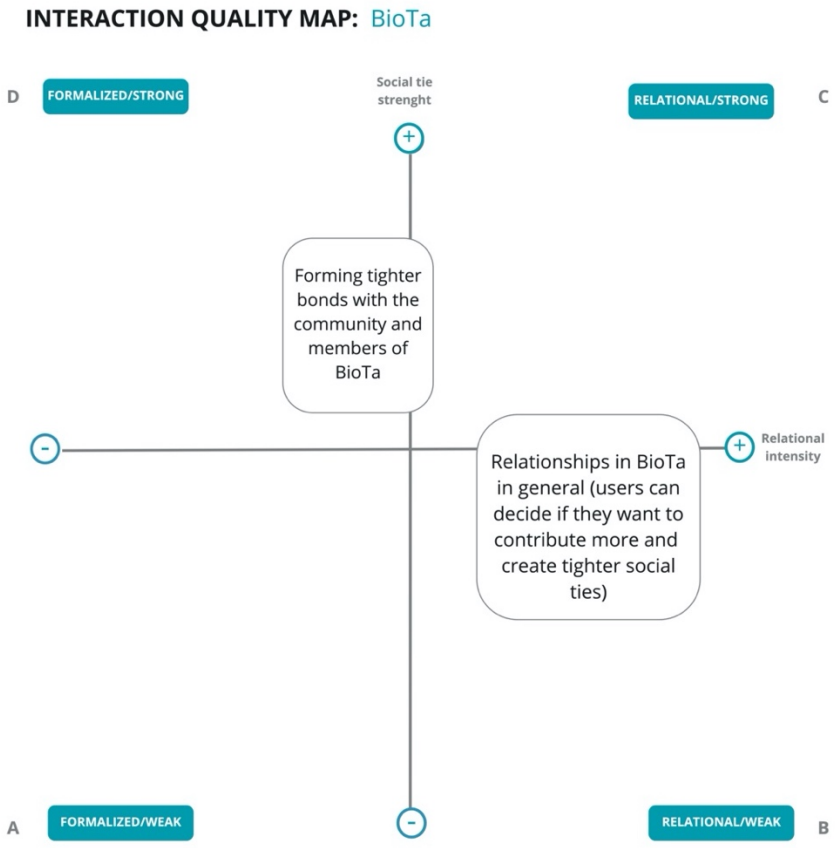

Figure 11: BioTa interaction quality map

As a digital platform, BioTa ideally also fosters interactions in real life – face-to-face collective encounters and thus shift from the IQ map's quadrant A to B and from A to C in order to form even tighter communal bonds (see Fig 18).

At the same time, city officials can achieve the shift from more formal and weak ties to a more effective relationship with the people and communities active in BioTa (from quadrant A to B or D).

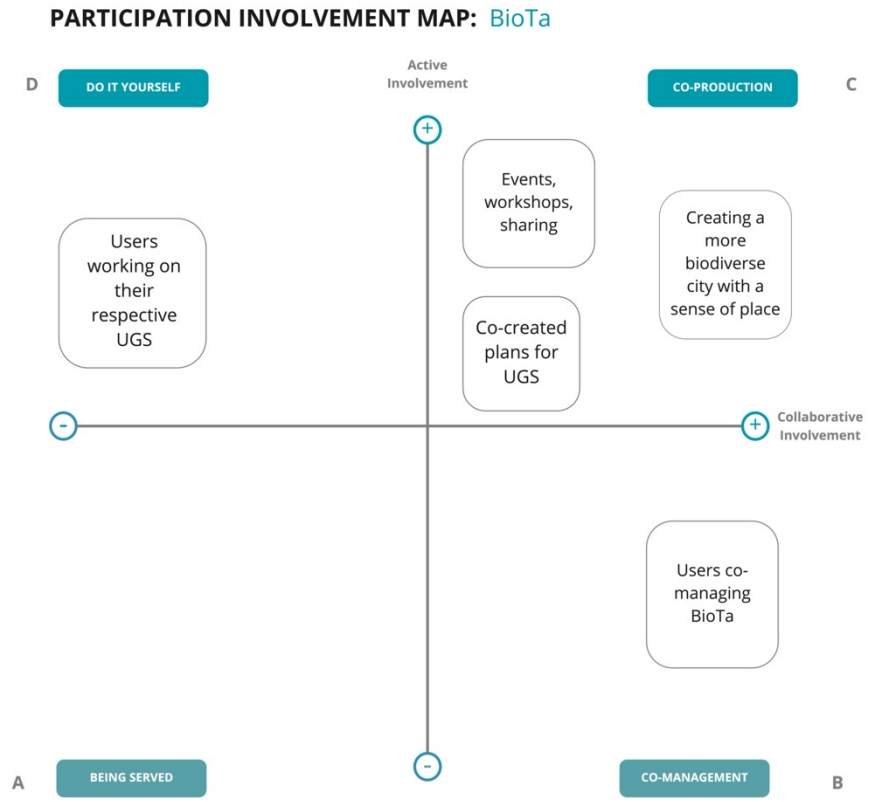

Figure 12: BioTa participation involvement map

On the scale of collaborative involvement, BioTa encourages people to work on their own UGS but also commit to the collaborative effort of turning the city more biodiverse. Though individual users will be still often working mostly alone with their UGS (PI map quadrant D), they have the means of being actively involved with other Biota members, meet up in workshops and share and learn from each other through the digital forum (quadrant B).

Communal users are usually already actively involved in collaborative work with their respective UGS (quadrant C), and hopefully also with other members through BioTa platform. The city administration, on the other hand, has the means to encourage its members to more actively seek out co-production and also co-manage the UGS forming BioTa jointly with all interested members (quadrant B).

Consequently, BioTa is a *collaborative platform* that intends to achieve a relevant and useful social objective but not demand too heavy involvement in terms of tie strength and intensity of the relations. On an individual level, all members can put it as much work as they prefer but the organizational level should not become too demanding or overwhelming

and can users should be able to decide how strong relationships they want to build with other members.

Designer Eric Roscam Abbing describes the role of users as co-creators: „As value is delivered through use, the success of a service solution will be partly dependent on the client. Therefore, the client's role changes from passive recipient of value to active co-creator. The role of the solution provider also changes from simply delivering a solution to a more facilitative role“ (Roscam Abbing, n.d.). Sharing Roscam Abbing's outlook, my intention for BioTa is also to rely on its active co-creators, in order to create a liveable habitat for plants, pollinators, humans, and other agents.

5.4. User journeys

As BioTa is not based on an existing service, user stories play an important role in playing out the different stages of the service. In order to describe how the users interact with BioTa through its touchpoints, I created relevant user journeys for individual BioTa user, City official and expert.

Urban beekeeper user group doesn't have a separate journey map, but their actions are consequently present in all three journey maps (see Appendices 2-4), as well as service blueprint (Appendix 5). As community user journey is quite similar to individual user's journey (Appendix 2) (differences appear mainly in the form of collective decision-making and shared responsibilities and legal and financial aspects), a separate map was not created for that user group. These user journeys were later used for building a detailed service blueprint map (Appendix 5).

Individual user

An individual BioTa user journey (see Appendix 2) is based on a hypothetical persona who lives in Tallinn in a private house with a medium-sized garden in with some flower beds, a few trees and a hedge, likes gardening but is not too educated about it. She has a young family and has recently started to care more about sustainability and nature protection and wants to contribute to the cause and at the same time, give an example to her kids.

The journey map shows how the user learns about BioTa, joins the initiative, receives a personal plan for managing her garden, and thus starts to follow the principles of biodiversity. It also shows the stages where the individual users cross paths with other agents in the system.

The user journey also opens up the main benefits related to steps in the journey. Naturally, there are also risks involved in the user behaviour such as abandoning the endeavour or not liking the result of it.

The main benefits, as listed, are easy onboarding through the personalised service (plan for the greenspace, flowering calendar) and step-by-step guidance, subsidising by the City. The benefits also include learning about ecology and biodiversity through one's actions as well as the best practices of other, forming tighter bonds with the community and the

feeling of accomplishment by the actions of creating a more diverse greenspace – a home for her family but also pollinators and other beings.

City official

I acknowledge the City as the initiator of BioTa, and therefore city officials play an important role in facilitating the everyday work and backstage actions related to BioTa (Appendix 3). They would have to serve as the link in the chain between the members and the City, especially in matters regarding allocating subsidies, registering new UGS and supervising the management of UGS owned by the City. It would also be a daring attempt at co-managing such an initiative. There is also the risk of budget cuts of reallocations or a change in management from the City that would affect the initiative.

Expert

Experts (e.g, biologist, ecologists or environmentalists) are essential stakeholders in the platform as they provide the relevant know-how and (scientific) information necessary for generating biodiversity plans. They also contribute to creating content for BioTa website and through Biota database, also an input for personal plans created by the algorithm and curate citizen science projects. Experts also help in the annual assessment of UGS.

In return, they receive a new data source (user data on UGS and from citizen science projects) for scientific work and planning. It is also worthwhile mentioning that one of the main benefits is playing a more active part in the decision-making process in planning the future of the City's greenspaces (see Appendix 4).

Naturally, there are also risks involved in the journey, such as an overload of work (especially during the spring and summer months) and possible disagreements with other stakeholders.

Other stakeholders:

Community user

Community users are made up of community gardeners, housing associations or other voluntary communities caring for a greenspace. Community users are often more actively involved in their causes and wish to be more actively involved in decision-making but also strengthening the social ties in the group or local neighbourhood. Community approach gives a feeling of support, helps to bind the community together): “The way to sustain life is to build and nurture community (Capra & Luisi, 2014, p. 355)".

The community user journey resembles the individual user journey in many aspects but also features a possibility to use different incentivization channels from the local authorities. E.g., in Tallinn community housing associations can already apply for a grant through the “Green Yards" campaign (*Hoovid Korda Toetus > Tallinn*, n.d.). After making some alternations (including the biodiversity principles into the requirements) this project could be incorporated into BioTa.

Various community events (following the “garden owner's calendar", courses, “talgud")

organized by BioTa members (including scientist-experts and the City) also make up an essential part of BioTa.

Urban beekeeper

BioTa enables urban beekeepers to view areas with potentially nectarous forage for bees and thus find the best locations for their hives. They can also directly contact managers of specific greenspaces with a request to establish an apiary enabling people to contribute to pollinators by hosting hives. It is also a channel for further explaining the importance of bees and address and educate people on their fears related to bees.

In addition to finding optimal locations for their hives, it also enables beekeepers to find new customers within the community and offer urban honey to local eateries, hotels and other vendors.

Vendors

Vendors are auxiliary users with looser ties to the platform. Their main interest is selling BioTa seed mixes and plants recommended by BioTa that users can buy directly through BioTa and use the subsidy for the purchase. BioTa provides them with potential new users and encourages the vendors to offer a wider variety of local plants and seeds, focusing on pollinator-friendly options and thus also contributing to creating biodiversity and pollinator protection.

5.5. Service blueprint map

As the next step, a service blueprint map was created (for a detailed map, please see Annex 5). According to PSE, a service blueprint maps out the resources needed to execute the (re)designed product-service system. It shows the visible actions of stakeholders both as information providers and information users, internal or unseen interactions of stakeholders and groups, the role of artifacts and services, and other support processes (Forlizzi, 2013).

The service blueprint focuses on individual BioTa users. The same service blueprint can be applied to community users as well with just slight amendments. Other key users are also accounted for at certain stages (experts, city officials, urban beekeepers, vendors).

With the objective of extending agency to pollinating insects, pollinators were put at the centre of the platform schematic. Such positioning compels us to ask from ourselves what actions and partnerships are needed in order to design for bees, butterflies and other pollinating insects adequately? Posthumanist theories also remind us that changing the status of other subjects besides humans means that people continue to hold their agency in this matter still as well. After all, it is people who have to make the decisions affecting the habitat of pollinators – either by choosing perennial local nectarous plants over annual exotics or deciding when to mow the lawn.

In order to recognize the importance of pollinator agency in the service, user actions affecting the pollinators are also put on the map (marked by an icon). The service blueprint

explains the services rendered by BioTa from the point of view of users. However, it also sheds light on the interweaved relationships, co-creation and co-management between different agents (stakeholders) in order to make the platform into a successful solution.

5.6. Branding and branded products

Branding carries an important role in the BioTa concept as it helps to convey a unified image and message and the raise awareness on the importance on biodiversity and pollinators, which is currently low (Uustal, personal communication, February 10, 2020). Additionally, it helps to validate or legitimize the actions of the members - especially in the open air where an otherwise unmarked greenspace or garden might be considered as neglected or let go.

Branding has also been successfully used, for example, in the Insect Highway project in Seattle (S. Bergman, personal communication, November 15, 2019).

As I am do not possess graphic design skills, I asked graphic designer Grete Siim to create a logo and some designed elements for the BioTa brand.
The result is BioTa logo (Fig 13), seed packages and sign, carrying the spirit of the brand described by keywords like joy, vibrancy and colour and the diverse urban mosaic.

Figure 13: BioTa logo designed by Grete Siim

5.6.1. Seed mixes for urban meadows

Natural meadow seeds gathered from Estonian meadows can currently be purchased from a single company in Estonia: Nordic Botanical (*NordicBotanical | Looduslikud Lahendused Maastikukujunduses*, n.d.) which has stemmed from the University of Tartu. Gathering the seeds is a time-consuming process, and the stock is limited (Fig 14).

Figure 14: Natural meadow seeds collected and sold by Nordic Botanical

If we aim to create sustainable urban ecosystems, we should also support creating (or re-creating) urban meadows within cities. Advocates for everyman's nature picture encourage people to pick their own seeds, but this takes extreme commitment (and also know-how), therefore in order to really make it accessible for laypeople, such seed mixes should be made available commercially – for example sold by selected vendors. Such action would give the contracted vendors to stock up on the seeds. Customers could purchase the seeds through BioTa and use the subsidy granted by the City for reimbursing the seeds. In order for BioTa to gain awareness and recognition, the seeds come in branded packages.

According to advice from Mart Meriste from Nordic Botanical, the optimal number of seed mixes for Tallinn would be 2-3 with roughly 1/3 species overlap, as over the years, the meadow seeds probably make an "trade" with plants growing in the neighbouring areas and develop new mixes (M. Meriste, personal communication, March 23, 2020) and looks.

I designed (with the help of graphic designer Grete Siim) two seeds packages (Fig 15): the first one focusing on daisies seeds and the second one bellflower.

As one of the main features of BioTa is providing users with step-to-step guides, more detailed instructions for planting the seeds and on tending to the evolving meadow patch can be found on BioTa web.

Figure 15: BioTa natural meadow seed mixes. Graphic design: Grete Siim

It must also be communicated to users who are interested in creating an urban meadow that the process takes a few years to develop and during the first year or two fully will not show its full potential.

5.6.2. Signage

Signs carry many functions: convey information, educate, communicate a sense and image of a place (or brand). BioTa sign (Fig 16), designed by Grete Siim and myself, helps to explain and "legitimize" the greenspace next to it in the eyes of onlookers who otherwise might feel puzzled or even contempt seeing a garden or park that doesn't fall into the category of a "typical" or "accepted" landscape design. Therefore, it helps to educate the general public about biodiversity, create awareness about BioTa and encourage people to look for more information related to the initiative.
Signage is also featured as an element is user stories (Chapter 5.4.).

Figure 16: BioTa sign. Graphic design: Grete Siim

The sign features the same vivid and joyful visual identity as the logo and seed packages in order to carry the BioTa brand.

5. BioTa systems communication

According to Forlizzi, this phase in the systems design process illustrates the future state to other stakeholders and to consider the implications of the design (Forlizzi, 2013). This is done by communicating the system's redesign in a clear and holistic manner.

Communicating the designer's vision is usually done in the form of a sketch or model, prototypes, enactments, and outcomes of new modifications to existing systems in order to inform and persuade others, allowing them to see the same things.

In order to communicate my solution to potential users and stakeholders, I created wireframes for Biota webpage but also used the user journeys, service blueprint map and seed packets and BioTa sign introduced in the previous chapter. As the proposed platform in a novel solution and not a redesign of an existing service, it took more a considerable time to explain the main goal and features of the system.

5.1. Information architecture and wireframes

Drawing out a simplified information architecture for the platform (see Appendix 6) helped me to figure out the overall composition of the platform and what views are needed for different user groups.

At this stage, I carried out a quick user test-consultation with a user with a background in IT. As a potential user of such a solution, he acknowledged and welcomed the main ideas behind BioTa. I used my initial wireframes for user testing and by going through the different characteristics. I also explained my troubles in deciding the necessary information fields in building wireframes for illustrating certain features of BioTa. It was also pointed out to me that in order to get a clearer focus on what information is required from BioTa on registering, I was also in need of a data model.

I used Google Appsheet in order to create a low fidelity interface prototype, a minimum viable product, illustrating how new users can be added to BioTa: what information is necessary to enter and how is a new UGS added to the map.

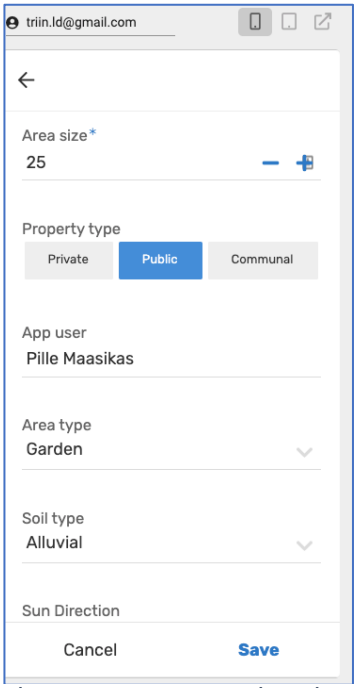

Figure 18: New UGS registration

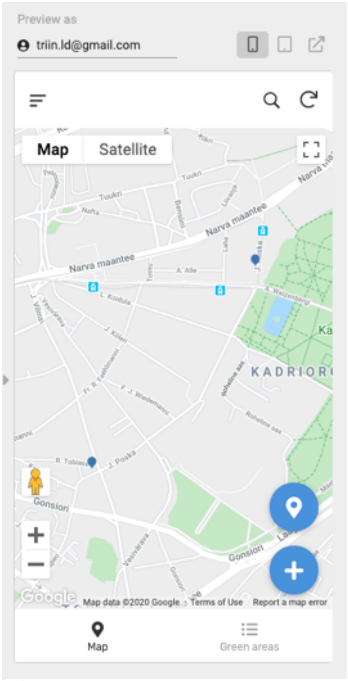

Figure 17: New UGS map

The first image (Fig 17) illustrates the registration process for new user after which the UGS is visible on the map (Fig 18), together with other member UGS. The low-fidelity prototype was then used for creating wireframes.

This step, although novel for me, proved to be extremely helpful in creating wireframes, as it gave me concrete realization about what information should be included in relevant user views.

Wireframes

In order to further illustrate the platform, I tried my hand in creating a few wireframes for BioTa homepage. I am in no means an expert in web design or UX, thus this should be considered as a modest attempt of a novice and not the work of a professional web designer.

The first wireframe (Appendix 7) acts more as a mood board or illustration of BioTa in order to introduce the platform to potential users. The next wireframe (Appendix 8) explains the workings of the flowering calendar where users can select the plants are already growing in the greenspace and use the BioTa recommendation engine to suggest other options to fill the gaps in the flowering calendar in order to provide forage for pollinators from spring to autumn.

The third wireframe (Appendix 9) is a high fidelity prototype of a new UGS registration process.

5.2. User testing and concept refinement

In an ideal situation, the user testing would have taken place face-to-face but due to the lockdown circumstances this spring, I had to opt for testing via video calls. It is unfortunate that I could not test the concept with fellow community garden initiators following a co-designing session, as was initially planned.

User testing was carried out with two users: an expert in community projects and gardening enthusiast, and an individual with no previous knowledge about ecology, environmental studies or gardening but who is currently in the process of starting with a (private) gardening project.

Using the video medium proved to be extremely difficult with many large-sized maps. As the proposed solution is a novel idea in the context of Estonia, explaining the main goal and inner mechanics took more than I had previously planned.

Both potential users took to the idea very well, one of them being more sceptic about the City's determination to start a new initiative (especially from the aspect of compliance with existing regulations and budgets). Nevertheless, these comments were more relevant to the municipality, rather than BioTa. I agree that I have been somewhat “optimistic" regarding the timeline, but I see this as the liberty a designer can take when proposing an idealistic solution.

Suggestions from the second user helped me in refining my wireframes and think through the bottom layers of the platform (e.g. information architecture).

In conclusion, the response from both users was supportive and did not point out any compelling mistakes from the user's point of view.

6. Conclusion

Designer Eric Roscam Abbing from a renowned service design company Livework studio has said:

> *„In order for design to be relevant in the Anthropocene it has to help reframe what we hold as valuable and dear to us, and how to unlock that value, without harming the ecosystem of which that value is a part.“* (Roscam Abbing, n.d.).

What are these values that we currently hold dear to us and how to reframe them resulting in more sustainable urban environment? A vision of future of cities becoming more biophilic – mosaics of landscapes with a sense of place and local for people, pollinators and other beings, seems an appealing future scenario to me and a worthy design cause. Therefore, I gave my humble try in designing BioTa, one possible solution space for the currently unresolved problem of incorporating environmental sustainability into urban greenspace design and as a solution to my research on how to support biodiverse urban greenspace creation and help pollinators to become active and acknowledged subjects.

Establishing a network of biodiversity-oriented and pollinator-friendly green areas in a city is quite an endeavour. Such actions take commitment, time, and money. In my opinion, if we want to take the pursuit of biodiversity from a grass-root initiative into another level, it has to involve more associates than citizens or even communities of citizens. Eventually, as it is the local authorities who make the decisions about urban (greenspace) design and the regulations that greenspaces maintenance has to follow, the municipality should play an integral role in the process. That is why the proposed platform takes a keen look into the different stakeholders involved in the attempt for building a more biophilic and pollinator-friendly city.

In the thesis I concentrated mainly on Tallinn. Nevertheless, I have to point out that in order for a solution like BioTa to succeed on a larger scale, it would need extending from the borders of the city into the surrounding areas. Such expansion would support a continuous “species rain" from the peri-urban and natural areas surrounding the metropolitan area and create a more impactful green infrastructure.

Nevertheless, the concept of BioTa is not tied to just Tallinn: mechanics and principles of the platform can be adapted to any other area. Adapting the platform would mean starting from the data layer as other areas would need different databases (especially, when talking about taking BioTa into other countries). However, the way how the different layers come together into the service are not country specific. This makes BioTa a scalable solution.

I also aspired for experts and scientists to be involved more in planning and decision-making concerning the urban environment. Designing cities, as a representation of ecosystems, need expertise and skill that not everyone possesses. This is why experts play an important role in BioTa. As the IPBES states:

> *“There has never been a point in human history where the state of nature has been so degraded, and the decisions we make about nature today have never been as critical. Creating a sustainable future means facing the twin threats of climate change and biodiversity loss head on – informed by the best available evidence and*

science." (*Media Release: Global Coalition for Biodiversity Launched on World Wildlife Day 2020 | IPBES*, n.d.)

BioTa is also about volume. As research pointed out that the best results for increasing biodiversity are the overall size of green areas, as well as management principles for such areas. This is why connectivity fostered by linking the existing green areas into a larger network is another key aspect that steered me towards the final concept iteration.

Last but not least I would like to touch upon the importance of pollinators once more. Many nature's offerings and resources are co-produced with people, but while people can enhance or even replace some of those contributions, others – such as pollination – are irreplaceable. This is one of the reasons why we have to look more closely (and humbly) at the tiny insects contributing to our daily meals and flowers blooming in the garden. Besides pollinators serving as a good proxy for assessing biodiversity, it is also important to extend agency status in urban greenspace design to bees, butterflies and other pollinating insects. Such shift in thinking helps to support and increase of overall biodiversity in an urban environment.

Without wishing to sound like a cliché, I can fully attest that this thesis project has been an eye-opening process for me. Hopefully, it has guided me towards becoming more ecoliterate and I hope that the body of work succeeded to carry my try at designing a more eco-centric solution also to the readers.

Much like the life-cycle of a start-up, to turn BioTa from a concept into a working product, the next step would be taking the idea to various events, incubators and accelerators, and building a minimum viable product. I also rather like the term “minimum *lovable* product", which means creating a version of the platform that brings the maximum of love from early adopters. An important step would also be pitching the idea to the City and building a team of representatives from all main stakeholder groups as BioTa is, after all, built on collaboration.

7. Summary

This thesis aims to design a solution for supporting and increasing biodiversity and pollinator protection in Tallinn and recognize the agency of pollinators in urban greenspace design. A framework of placemaking and posthuman theories on nonhuman agency was used. The structure follows the process of systems design and product service ecology. A research question was formulated: how to support biodiverse urban greenspace creation and help pollinators to become active and acknowledged subjects?
Research, case studies and interviews with stakeholders indicated that linking green areas, appropriate greenspace management, co-creation, and focusing on the needs of pollinators as equal agents, are essential in designing more biophilic cities habitable for all life.
As a solution, a biodiversity platform was designed that connects urban dwellers, city administration officials, subcontractors and experts in supporting and increasing biodiversity and protecting pollinators.
The concept is illustrated by a schematic map, user journeys and service blueprint map. In order to test the concept, user tests were conducted, and wireframes were designed.
The thesis concludes that hat by offering users personalized plans and step-to-step guides, co-management and linking green areas the proposed platform helps to sustain biodiversity and pollinators in the urban area.

Kokkuvõte

Magistritöö eesmärgiks oli disainida lahendus, mis vastaks töö peamisele eesmärgile: kaitsta ja kasvatada elurikkust linnas ja arvestada linna rohealade loomisel ja kujundamisel seal elutsevate tolmeldajate vajadustega. Töös kasutati kohaloome ja posthumanistliku mitteinimeste agentsuse raamistikku. Struktuuri loomisel oli abiks süsteemse disaini, konkreetsemalt toote ja teenuse ökoloogia printsiibid.

Magistritöö uurimismeetod on kvalitatiivne ja toetub elurikkuse, tolmeldajate, ning linnaökoloogia alasele kirjandusele, näidetele ning ekspert- ja kasutajaintervjuudele. Uurimistulemustele põhinedes jõuti järeldusele, et liigirikkuse ja tolmeldajate kaitse tõhustamisel on olulisteks teguriteks rohealade liitmine, elurikkust toetavate hoolduspringsiipide järgimine, koosloome ning tolmeldajate kui subjektide kohtlemine inimestega võrdväärsetel alustel.

Lahendusena disainiti linnakeskkonna elurikkust ja tolmeldajate rolli olulisust toetav platvorm, mis toob ühise eesmärgi nimel kokku linnaelanikud (nii eraisikud kui ka seltsid ja ühingud), linnaametnikud (ning linna alltöövõtjad) ja eksperdid.
Platvormi tutvustamiseks ning selle funktsionaalsuse avamiseks kasutati platvormi skeemi, kasutajateekonna kaardistusi ning teenuseplaani. Kontseptsiooni testimiseks viidi läbi kasutajateste ning platvormi kodulehe ülesehitust ilmestavaid raamistikke.
Töö kokkuvõttes leiti, et elurikkuse ning tolmeldajate kaitsel on enim abi detailsetest rohealade hooldusplaanidest ning erinevate huvigruppide koostööst rohealade liitmisel suuremaks võrgustikuks.

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8. Figure List

9. Appendices