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Comparing approaches towards spontaneous vegetation in urban green structures

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Landscape Architecture for Global Sustainability

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Acknowledgements

Through five years of studying, it has made more and more sense to me that my ambitions and curiosity in life is not just about how to create the most aesthetic environment alone, but to create ecologically and sustainable landscapes for all species as well. That is why I was eager to study spontaneously appearing vegetation in urban landscapes. The vegetation cities look at with sigh and spend lots of resources to remove. That thrives in the most disturbed landscapes with poor conditions and little love.

This thesis marks the end of a two-year long master's degree in "Landscape architecture for Global Sustainability" at the Norwegian University of Life Science (NMBU). It is written in the spring of 2024.

I want to thank my supervisors Line Rosef and Katinka Horgen Evensen for strict and engaged guidance through these past months, and I want to thank my boyfriend for tolerating my good and bad days and always supporting me. I also want to thank friends and family for believing in me, and lastly, I want to thank Jonas Meyer for helping me with German translations when Google was not enough.

The thesis is written with a color theme based on red to burgundy colors on a mellow cream-white background. The red tones are chosen to avoid the stereotypy of vegetation being represented as something green or earthy in colors. Weeds are typically considered messy and unattractive, and it comes with risks of invasion and elimination, but the perception can change through an ecological perspective. I therefore chose to use red tones because the stop or warning-signs are usually represented in a bright red color, while I wanted to tone the red down and make it more aesthetic and acceptable.
All photos, tables and illustrations are made by me.

Ås, May, 2024

Kristine Andersen

Abstract

Urbanization causes negative environmental effects and leads to pressure on the nature within and surrounding cities. Increasing the levels of wildness in urban areas is a form of nature-based solution that can improve the biodiversity and improve residents' well-being.

This study aims to find green structure approaches towards urban spontaneous vegetation in today's Berlin, Germany and Oslo, Norway. This is done through document analysis of the cities' planning documents.The overall aim for the Berlin documents can be summarized as a wish to expand nature and wilderness in urban development areas, conserve biodiversity and ensure green access and high-quality environment for the residents. The overall aim of the Oslo documents is to design the urban landscape with local and sustainable measures, make a safe and attractive parks and open spaces.

This study finds that Berlin has a general positivity towards foreign species and monitor invasive species, while Oslo is negative towards foreign species because of the threat they put on Oslo's indigenous species.

Berlin looks at all green structures as part of biodiversity, even spontaneous vegetation, while Oslo wants preserve biodiversity by designing urban green spaces.

The background history and available land may be a factor that decides the acceptance towards urban spontaneous vegetation.

Both Oslo and Berlin have a high construction development pressure, while only Berlin has sufficient land available for construction. Small patches of vegetation have a higher amount of invasive or foreign species, and indigenous species has a higher risk at surviving in bigger patches.

Table of Contents

1. Introduction

1.1 Background

Biodiversity is the diversity of all the living nature on earth, and is responsible for the earth's access to air, water, weather, and food (Altman, 2023). Through billions of years of evolution and natural processes has earth's biodiversity been shaped but is more and more of the biodiversity are influenced by humans (Rawat & Agarwal, 2015).

The urbanization has made the world face a biodiversity crisis and part of it is because human disturbance and urbanization is affecting ecosystem processes and the ecology of organisms (Butchart et al., 2010; Ruas et al., 2022). When vegetation patches are fragmented or completely lost, it can result in several species losing their habitat (Brynildsrud, 2022)

A fragmented landscape with isolated habitats hinders species to spread, and can be
damaging for biodiversity, because the patches will be left vulnerable for extinction (Thompson et al., 2015; Winkler et al., 2024). Large patches of urban wilderness are getting rarer in dense cities, but small interventions with wild vegetation can still bring biodiversity to the densest built environments (Ilie & Cosmulescu, 2023).

Figure 1: A bucket with spontaneous vegetation in Berlin

1.1.1 Weeds for biodiversity

Expansion of urban landscapes is causing fast degradation of lands. The global population is expected to reach 10 billion by 2056, and 66% of this population is expected to be situated in urban landscapes (Ferreira et al., 2018). Although only 3% of today's globe is occupied by urban areas, and urban environments only increase with around 0,5-0,6% per year, suburban areas expand four times faster (Ferreira et al., 2018). Urbanization causes negative environmental effects, and cause pressure on the nature within and surrounding cities. Primary, urbanization cause the erase of existing vegetation, which lead to secondary effects, such as fragmentation, local climatic change, increased spread of invasive species, contamination of soil, air and water, and loss of biodiversity (Ferreira et al., 2018; Ruas et al., 2022).

In 2015, the United Nations (UN) created an "Agenda" with 17 "Sustainable Development Goals", and a total of 169 targets that among others, seek to protect the planet from degradation by 2030 (UN, 2015). Goal 15.5 describes that there should be taken urgent and significant actions to minimize the degradation of natural habitats, stop the biodiversity loss, and by 2020 prevent and protect threatened species from going extinct (UN, 2015). Goal 15.8 also describes that by 2020, measurements to prevent introduction and reduce impact of invasive and foreign species on land and water significantly, and to control priority species. (UN, 2015).

Goal 15.9 further describes that by 2020 values for ecosystem and biodiversity should be integrated in local and national planning and development processes (UN, 2015).

Odum and Barrett (1971) describes the urban landscape to be "only parasites in the biosphere", yet the humanity is continuing to build urban environments, even though we are dependent on nature for our survival (Bolund & Hunhammar, 1999), but most green structures in urban areas still contribute as ecosystems, even though they are managed and manipulated by humans. Distant ecosystems will not improve the local air quality and noise levels in an urban area (Bolund & Hunhammar, 1999)

Vegetation that is robust, early successional, and colonizing without interference with humans often naturally occur in landscapes with high levels of disturbance, heat retention and impervious paving, which urban environments offer (Del Tredici, 2010; Deparis et al., 2023). Commonly, this vegetation can be known as “weeds”, but the perception of this vegetation has changed. Some designers and residents now look at this vegetation as s omething attractive, and sometimes it is intentionally included in their design (Sikorska et al., 2021). In this thesis, when mentioning these plants that sprout in abandoned land with little to no maintenance, the word “weed” will be avoided. Instead, spontaneous vegetation or urban spontaneous vegetation be used.

Spontaneous vegetation in the urban landscape can play an important role in the support of humanly caused disturbed environments. They have a strong ability to self-organize, different strategies to adapt to the location as well as cultural and ecological functions (Chen et al., 2021; Sikorska et al., 2021). Increasing the levels of wildness in urban areas is a form of nature-based solution that can improve the biodiversity, reduce management costs, and improve residents’ well-being (Farruggia et al., 2022; Sikorska et al., 2021).

Figure 2. Spontaneous vegetation sprouting through an old bench in a backyard in Berlin

1.1.2 Messy is attractive as long as it is tidy

It is up to the city dwellers to decide how they want their city to be portrayed. A neat and tidy landscape can represent structure and hard care-work, while it has fewer ecological benefits than a natural landscape (Nassauer, 1995). A messy, natural landscape tend to have much more ecological qualities, than the constructed new landscapes. "*What is good may not look good*" and vice versa (Nassauer, 1995, p.161).

Nassauer's (1995) article presents a review of how aesthetic a study group found a suburban garden based on different levels of natural vegetation implemented. She found that neat and heavy maintained lawns were associated with attractiveness, while a weedy lawn was associated with unattractiveness. Interesting enough, a mixed lawn, with both cut grass and indigenous prairie was also considered attractive (Nassauer, 1995).

A similar study was more recently done by Fisher et al. (2020). 2027 residents of 19 European cities, in nine different countries were asked their preference of a park that is illustrated as short cut versus tall grass meadows. The overall results showed that the short cut grass was more appreciated than the untrimmed grass, but the population was also positive towards biodiversity, if the appearance was neat and tidy (Fischer et al., 2020) This means that residents in general appear to willingly accept ecological facility interventions when they understand what benefits it contributes to, even though they do not look as tidy as previously vegetation design.

Kühn (2006) recommend the use of urban spontaneous vegetation for ornamental purposes in the urban environment. He argued that spontaneous vegetation was something authentic, forever suitable to the local conditions and cost-effective.

Their establishment without financial cost and requirement of less maintenance than traditional ornamental plantings gave them an environmental value, as nature contributes to the natural dynamic of urban ecosystems and enhances biodiversity (Kühn, 2006).

Figure 3: Spontaneous vegetation in a roundabaout in Berlin

1.1.3 Intruders and design implementation

One can imagine that a common denominator for "green" equals "good". Which is not exactly wrong, because vegetation does give a lot of ecological qualities, but some species can also be threatening.
Usually, foreign and invasive species comes along with the introduction of urban spontaneous vegetation. An important note is that not all foreign species are invasive.

When referring to invasive species, it is referenced to the foreign species that establishes a monoculture and eliminates the original flora (Marushia & Holt, 2008). They often spread in urban environments because of the highly trafficked landscape, through tourists, trade and through seeds from garden plants (Gaertner et al., 2016).

Foreign and invasive species often has a great ability to adapt and spread quickly and they can also have an survival advantage to the indigenous species, because the disturbance they have been through has made their spread and establishment enhance (Borden & Flory, 2021; Gaertner et al., 2016).

Borden & Flory (2021) claims that indigenous species also can adapt to urban conditions, but that they are often outcompeted from the most disturbed landscape and must settle in more natural habitats. They also speculate that the urban evolution could cause development of urban specialists, that reduces the possibility for them to spread outside the urban areas. Although there is little evidence that backs up this theory (Borden & Flory, 2021).

Many foreign species thrive in the warm temperatures and disturbed landscapes of the urban environment, and therefore establishes and spread easily (Gaertner et al., 2016)

Gaertner et al. (2016) still argues that urban management should have acceptance of some invasive species in areas that are so transformed that there will not be possible to restore the original ecosystem.

Maintenance such as mowing or weeding is crucial for the sustainability and aesthetics of the urban spontaneous vegetation (Czortek & Pielech, 2020). If care is not provided, succession can lead to an overgrown, homogeneous landscape (Kühn, 2006). Čepelová & Münzbergová, (2012) found that edge zones of nitrophilous tall herbs and shrubs can prevent invasive species with short-distance seed spread, which can be suitable as a buffer zone in urban areas. Regular maintenance will also promote biodiversity within the plant communities, and prevent the spread of the invasive species, as well as the visual appeal of the site will be more attractive (Kühn, 2006).

With the expansion of cities it is necessary to find ways to maintain the biodiversity and ecosystems in the urban environments (Winkler et al., 2024). One example is expressed in Deparis et al., (2023), where Blois, a French mid-sized city has reduced their focus on removing the spontaneous vegetation, and applied measures to reduce maintenance costs and get the inhabitants of the city to understand the biological effects of the spontaneous vegetation. If people are provided the ecological benefits of "messy" vegetation, their perception of aesthetic appreciation can change, because they now understand the values that are featured in an ecological landscape (Gobster et al., 2007).

Winkler et al. (2024) points out that urbanization can cause artificial biotopes that generate suitable habitats for spontaneous plant development and works as corridors, namely tram lines. Their study confirms that the linear structure of the tram line not only makes it possible for invasive species to spread more sufficiently, but also increases the biodiversity with native species (Winkler et al., 2024).
Kühn (2006) explains that different design interventions and strategic planning can make urban spontaneous vegetation visually appealing. For example, the spontaneous vegetation can be mixed with ornamental plantings, or the spontaneous vegetation can be a contrast to the surrounding built landscape:

> *Spontaneous vegetation in uncared-for surroundings appears uncared for. For this reason, everything must be put into effect in accordance with the appropriate landscape architectural design in order to create the desired effect.*
> (Kühn, 2006, p.51)

1.2 Objective & research question

This study aims to find green structure approaches towards urbanspontaneous vegetation in todays Berlin, Germany and Oslo, Norway. The cities are selected to get a comparative study between two cities in Northern Europe, with similarities in climatic zones and with goal of being "green cities" (Moen, 1998; Reuter & Erb, 2024; SenSBW, 2022; Engvik & Strand, n.d.; Strand, 2023).

To complete this objective, I have made two research questions:

- **What green structure approaches towards urban spontaneous vegetationcan be found in current city plans in Berlin and Oslo?**

- **How can we understand the background of their choice of green structure approach?**

Figure 4: Contrast in vegetation between two trees in Berlin

2. Method

2.1 Methodological approach

To find suitable information about Berlin and Oslo's approach towards urban spontaneous vegetation in green structure, I have conducted a qualitative content analysis, and analyzed different city documents from both cities. The documents I wanted to find should ideally be focusing on urban nature, urban guidelines, biodiversity and maintenance.

When the suitable documents were found, I searched for the aim of the individual document and checked for the different cities focus on urban spontaneous vegetation by doing a registration analysis to show the frequency of occurring keywords related to urban spontaneous vegetation in each document. This was done by searching for specific keywords that has a connection to green structure and management and putting them in an overview table.

Since the representation of the different keywords does not say enough about the different cities approach towards urban spontaneous vegetation alone, but rather explains whether the documents describe the potential and relevant information that I am searching for. I summarized what way the different keywords were used in the documents, and categorized them into the categories "positive", "negative" and "neutral" regarding how the word is used in setting of urban spontaneous vegetation. This was done to reduce misunderstanding of word representation.

2.2 Case selections

Berlin and Oslo were strategically chosen to be studied because they share a similar interest in being “green” cities (SenUVK, 2020; Oslo Kommune, 2023). Both cities are also the capitals in their respective country (Germany and Norway) and has the largest population in their country. They are both also facing development pressure (SenSBW, 2022; Strand, 2023).

As a contrast, Berlin is almost double the size of Oslo, and has a 5 times larger population (Reuter & Erb, 2024; SenSBW, 2022; Engvik & Strand, n.d; Strand, 2023). They also have a different geographic placement, even though they are both in the nemoral and boreonemoral zone (Moen, 1998). Oslo is placed in the inner Oslofjord with connection to the sea, while Berlin is placed in the inner lands of north-east Germany (fig. 5).

Figure 5: Map of Berlin and Oslo

2.2.1 Berlin

Berlin is the largest city in Germany and is also the capital of the country. The city area is 894 square kilometers (Reuter & Erb, 2024), and as of 2021 has a population of 3 775 000 (SenSBW, 2022). It is estimated that there will be an increase of 187 000 inhabitants by 2040, which gives a new total of 3 963 000 inhabitants (SenSBW, 2022). Compared to other European metropolises that often has a shortage of available land for housing development, there is still sufficient land available for housing development in Berlin (SenSBW, 2023).

The city is situated north-east in the country, in a wide glacial valley of the Spree River. The city is elevated 35 meters above sea level, and is mainly built on sandy glacial soil, surrounded by a belt of forest rimmed lakes (Reuter & Erb, 2024).

The climate is influenced by both the Atlantic Ocean and the continental plain, as it is placed where the Atlantic Ocean fades, and the continental plain begins (Reuter & Erb, 2024), in nemoral and boreonemoral zone (Moen, 1998). Temperatures vary from a mean of -1°C in the wintertime, to 18°C in the summertime. Which makes the annual mean temperature 9°C. The average annual precipitation is 568mm (Reuter & Erb, 2024). The hardness zone is 7B in the German "Winterhärtezone", which translates to H2 in the Norwegian scale of hardness zones (GartenHit24, 2023; Bjørkans planteliste, n.d.).

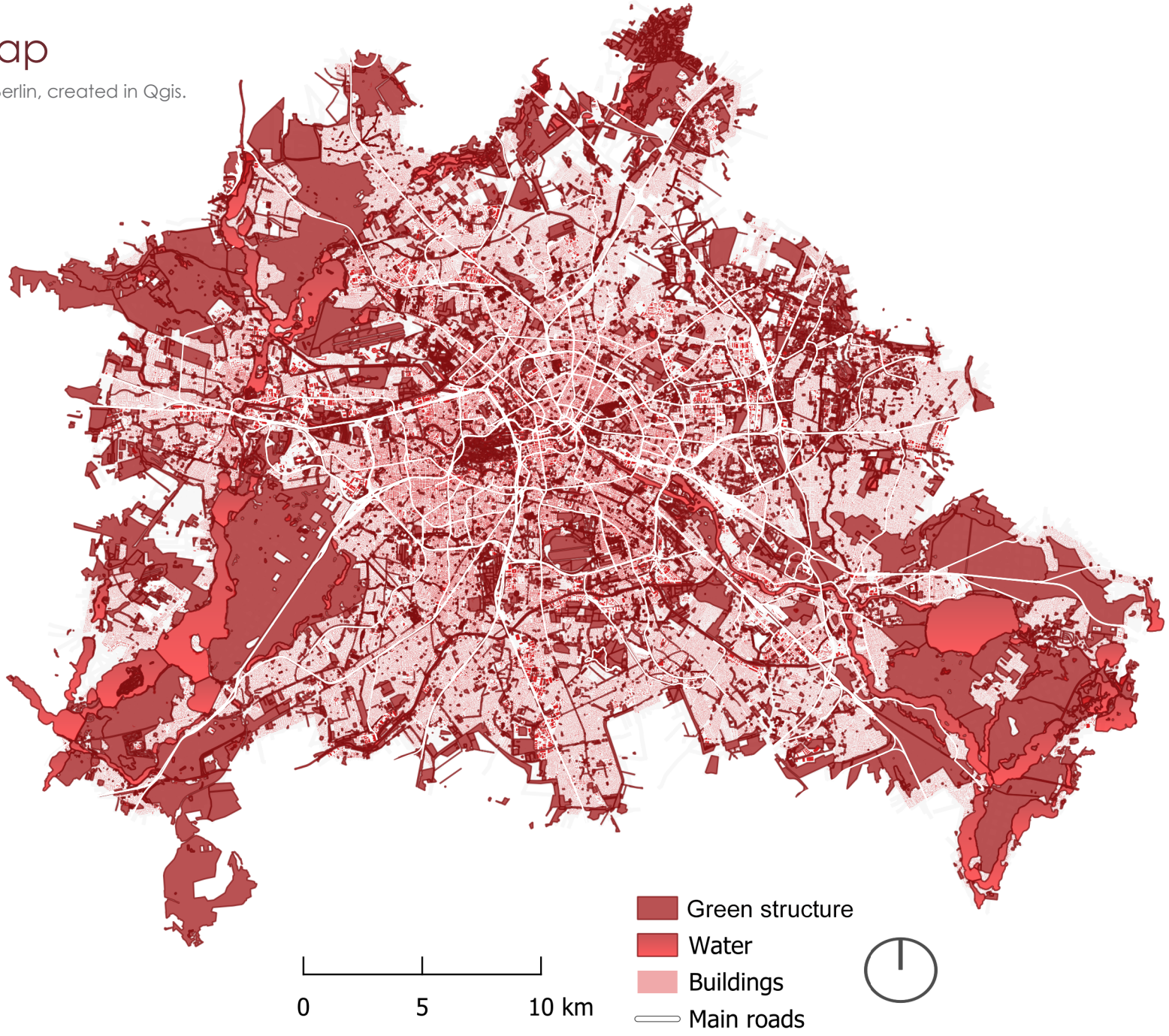
The city offers big and small urban forests, public parks, green city squares and streets and public and private gardens (fig. 6). All these resources shapes Berlins cityscape and lifestyle and makes Berlin one of the most biodiverse cities in Europe (SenUVK, 2020).

Berlins unique socioecological assemblage is very rare anywhere else, with brownfields, urban wastelands and neglected landscapes (Gandy, 2022b). After the second world war, rubble landscapes were naturally embraced by spontaneous growth, which was considered as closure, with Matthew Gandy (Gandy, 2022a) using the words "symbolic redemption", "visual occlusion", and "tabula rasa". The blanket ofvegetation was in other words working as a cover of the past (Gandy, 2022a). These places are known as "Brachen" in Germany, and are generally appreciated by the residents of the city (Gandy, 2022b).

These places are working as ecological refugia of biodiversity, because of how abandoned spaces host a large variety of invertebrates, reptiles, birds, and plants (Vessel & Wong, 1987). During the 21st century, many of these landscapes has been transformed into development (Gandy, 2022a; Lawton et al., 2019)

Berlin Map

Figure 6: Map of Berlin, created in Qgis.



2.2.2 Oslo

In the nemoral and boreonemoral zone (Moen, 1998), south-east in Norway, at the heart of the Oslofjord, is the municipality of Oslo placed; Norway's capital, and largest city (fig. 7). Per January 2024, the population was 717 710 (Engvik & Strand, n.d.). It is estimated that the city's population will be at around 813 000 in 2050 (Strand, 2023), and the demand of housing development in the city is higher than the supply (ESA, 2023). This can make a pressure on the nature in the city.

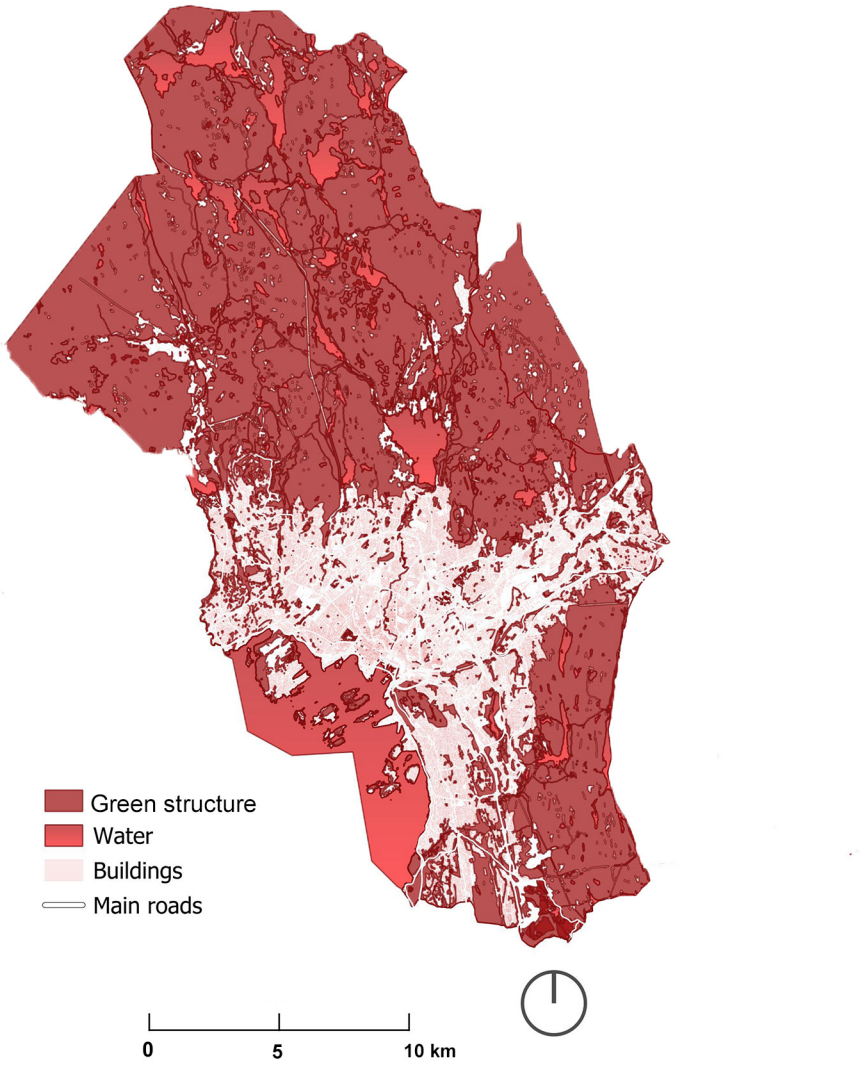
The annual mean temperature is 7,0°C, with –2,3°C as the average temperature in January, and 17,7°C on average in July (Dannevig, 2023). The hardness zone is H3 according to the Norwegian scale of hardness zones (Anderssen, 2020).

The landscape is shaped by geology and glaciation (UiO, n.d.). Total area is 454 square kilometers, but 300 of these square kilometers is in Oslomarka, which is the contiguous areas of forest and open field around Oslo (Thorsnæs & Tvedt, 2024). The biodiversity is rich, but development points to loss of green spaces due to new construction, fragmentation, overgrowth, pollution and spread of invasive species (Oslo Kommune, 2023).

Oslo is considered a green city with natural qualities, but the access to green spaces and parks have been declining (Beatley, 2012). The outer area of the city has the highest number of green structures, while the inner city has the lowest. The inner city is the densest, which makes it a challenge to provide green features. (Beatley, 2012). The disturbance and high density of the city makes it a "hot-spot" for foreign species and can be a threat for the indigenous species (Statsforvalteren, n.d.).

Oslo Map

Figure 7: Map of Oslo, created in Qgis.



2.3 Protocol

Inspired by Nordh and Olafsson's method, (2021), a protocol with choice of variables were developed for the analysis of the plans:

- Which city is the document from
- Name of plan
- Year of approval
- Number of pages
- Usage of relevant keywords

(Spontaneous", "Weed", "Invasive", "Maintenance", "Foreign" and "Biodiversity")

- Positive, negative, or neutral usage of keywords
- Overall aim and strategies for specific document

The text sections that matched the protocol variables in the different documents were collected and analyzed.

Figure 8: Spontaneous vegetation in Gleisdreieck, Berlin

2.3.1 Document analysis

To examine Berlin and Oslo's approaches toward spontaneous vegetation in urban green structures, I collected current planning documents that I found in the official websites for Berlin and Oslo. I searched for plans and documents that had a focus on green structures, management, and biodiversity.

I found that both cities have a strategy document for biodiversity: *Berliner Strategie zur Biologischen Vielfalt* and *Handlingsplan for biologisk mangfold i Oslo 2023-2030*. I also found that Berlin has a general maintenance document: *Handbuch Gute Pflege, Pflegestandards für die Berliner Grün- und Freiflächen* describing how different types of green areas should be maintained. The same type of document did not exist for Oslo, but I found a supervisor for urban design: *Veileder for bymessig utforming* and a document about park instructions: *Parkinstruksen: Planlegging, utforming og overlevering av nye anlegg i parker og friområder*.

I also investigated "Berlin Urban Green": *Charta für das Berliner Stadtgrün*, which is the latest published documents about urban green structures in Berlin.

I could not find a similar plan for the green structures of Oslo. For simplicity will use the English translation of the document names in the rest of my thesis (table 1).

Since the documents from Berlin were written in German, I used Google Translate's "document"-function to translate whole documents to English to get a better understanding of what is written. I have double checked some unclear sentences with a German-Norwegian speaker, to clarify and translate some sentences and make sure that I am not misreading the documents. I translated the Norwegian documents into English as well, to check how well they were translated into English, and get an understanding of how well thetranslation function worked.

Table 1: Overview of analysed documents

Berliner Strategie zur Biologischen Vielfalt (2012, p.47) Berlin Strategy for biodiversity
Handbuch Gute Pflege, Pflegestandards für die Berliner Grün- und Freiflächen (2017, p.227) Berlin Good Care Handbook, care standards for Berlin's green and open spaces
Charta für das Berliner Stadtgrün (2020, p.24) Berlin Urban Green
Handlingsplan for biologisk mangfold i Oslo 2023-2030 (2023, p.45) Oslo Action plan for biodiversity in 2023-2030
Parkinstruksen: Planlegging, utforming og overlevering av nye anlegg i parker og friområder (2023, p.22): Oslo Park instructions: Planning, designing and delivery of new facilities and open spaces
Veileder for bymessig utforming (2019, p.99): Oslo Supervisor for urban design

2.3.2 Registration of keywords

To analyze the representation ofrelevant focus on urban spontaneous vegetation in each document, I registered of how many times a relevant keyword occurs in the different documents. The keywords that were searched for was chosen because they are highly likeable to have a link to spontaneous urban vegetation.

The keywords have been structured into categories based on whether the word is a "**Type**", is "**Descriptive**", an "**Action**" or an "**Effect**". The words are not written in a hierocratic order but are all equally considered relevant for the research question. The reason for evaluating all the different keywords as similarly relevant is because the context of the text where the keyword is used decides the importance of each keyword. The keyword context will be studied later.

Both English, German, and Norwegian have different synonyms for a single word, and the documents have in many cases used different expressions for words with the same meaning. I chose to search for different synonymous words in each language as well (table 2).

Table 2: Main keywords written in thick font, while synonymous keywords are written in regular font

	English	German	Norwegian
Type	Weed Unwanted growth	Unkraut Unerwüscht (unkraut)	Ugress Ugras
Description	Spontaneous Wilderness Natural	Spontan	Spontan Vilt Naturlig
	Invasive	Invasiv	Invasiv Invaderende Dominerende
	Foreign Non-native Alien	Fremd	Fremmed
Action	Maintenance Care Conservation	Pflege Erhaltuung Betreuung	Vedlikehold Skjøtsel
Effect	Biodiversity Biological diversity	Biodiversität Biologische Vielfalt	Biodiversitet Biologisk mangfold Naturmangfold

To analyze each document's focus on urban spontaneous vegetation, I did a summarized registration analysis and created an overview of how often the individual document of each city was mentioning the different keywords. The tables only consist of the English main keywords' occurrences that are written in a thick font in table 1: "**Spontaneous**", "**Weed**", "**Invasive**", "**Maintenance**", "**Foreign**", and "**Biodiversity**", but they cover the other synonyms mentioned in table 2 as well. I have put the tables with both English/German and English/Norwegian registrations in the appendix (table 7 & 8).

I chose to exclude the German and Norwegian registrations in the tables in the "Result" chapter because they made the tables harder to read.

To double check my registrations, I have also collected registrations based on the German expressions: "**Spontan**", "**Unkraut**", "**Invasiv**", "**Management**", "**Pflege**", "**Fremd**" and "**Biodiversität**", and the Norwegian expressions: "**Spontan**", "**Ugress**", "**Vedlikehold**", "**Fremmed**" and "**Biodiversitet**". These registrations are done in the original documents to prevent loss of translation errors. The registration was done by using the search-button in Adobe Acrobat and typing in the different words separately.

By registering the occurrences of each word, I was able to validate the translation of the documents by checking if the same number of keywords were occurring in the translated documents. The Berlin documents are comprised of more pages in total than the Oslo documents. Directly comparing each city's focus of urban spontaneous vegetation purely by word occurrence could possibly be misleading. It is reasonable to assume that word occurrence increases with the number of pages. Therefore, to allow for a fair comparison between the Berlin and Oslo documents respectively, the frequency (Ω) of each keyword is calculated.

This was done by adding together the total page numbers for the Berlin and Oslo documents separately. The occurrences of each word were then divided by the sum of the total page number corresponding to the different cities. The result shows a frequency based on the appearance per page on average. This ratio was then expressed as percentages by multiplying the frequence by 100. This is added in a column in the table to show the percentage of each frequency (Ω%).

For example, if a city's total page number across documents is 1000, and a word is mentioned 100 times in total across the documents, then the frequency, denoted by Ω, of word occurrence per page is 0,10 or 10%.

The registrations of the different words I searched for were put into two tables to get an easy overview on how often the expressions are used in each plan and in the different cities.

2.3.3 Categorization of keywords

To avoid misreading of the occurrence frequency of keywords, I created an overall table for registering if the different keywords were used in a "**positive**"(), "**negative**"(), or "**neutral**" () context regarding spontaneous vegetation in the different documents.

This was done by searching for the different keywords and their synonyms in the different documents, getting a personal perspective of what context the different words are used for, and if it appeared positive, negative, or neutral. I made sure to only rank the occurrences that were linked to spontaneous vegetation, and nothing else, even though many of the words were appearing in other settings as well. If the specific keyword had zero occurrences in the document, it was registered as "**not applicable**" (N/A) in the table.

3. Results

3.1 Registration tables for Berlin and Oslo

Out of the three Berlin documents analyzed (table 3), the highest amount of keyword registrations found in the "Berlin Good Care Handbook". This document contains examples of every word searched for, while the "Charta for Berlin" only has registrations of the word "maintenance" and none of the others searched for.

In total the Berlin documents show a very high appearance of the word "maintenance". The word is registered in total 1247 times, which is an average appearance of roughly 4 times per page (418 Ω %).

The second most frequently appearing keyword is "biodiversity", with a frequency percentage at 106%, which means that the word on average is occurring a little more often than once per page. "Biodiversity" is well represented in all the three documents, but is appearing most times in the "Berlin Strategy for Biodiversity".

The keyword "Spontaneous" appear fewest times with only 17 registrations, which means that the word occurs about once every 17th page. The word "weed" is not mentioned in any other document than the "Berlin Good Care Handbook", but it is appearing 51 times in this document.

This causes a frequency percentage of 17% per page in total. That means that the word "weed" occurs once almost every 6th page."Foreign" is also mentioned a total of 51 times, which gives 17 as frequency percentage per page, and occurrence a little less than once every 6th page as well.

Table 3: Frequencies of keyword occurrences in Berlin documents

		Berlin Strategy for biodiversity (p. 47)	Berlin Good Care Handbook (p. 227)	Berlin Urban Green (p. 24)	Total	Ω	Ω %
Type	Weed	0	51	0	51	0.17	17%
Descriptive	Spontaneous	1	16	0	17	0.06	6%
	Invasive	3	19	0	22	0.07	7%
	Foreign	22	29	0	51	0.17	17%
Action	Maintenance	131	1091*	25	1247	4.18	418%
Effect	Biodiversity	221	79	17	317	1.06	106%

p. is the number of pages in each document.
Ω is the frequency of how often the different words appear per page.
Ω% is the frequency showed in percentage.
*The title of Berlins "Good Care Handbook" includes the title in each page throughout the document. Since I was researching for the word "Care" in my registration of maintenance synonyms, I chose to subtract the total number of pages the document has (227) from the total number of registrations I found. The result is written with an asterisk symbol in the table.

The Oslo documents (table 4) has in overall relatively few total-registrations of all the keywords searched for, compared to the Berlin documents. “Maintenance is the most appearing word, and occurs in all the documents, and has a total of 143 registrations, and a frequency of 86 percent, which means that it on average occurs one time in almost every page. In contrast, the word “invasive” has zero occurrences throughout every document.

Like the Berlin documents, “Biodiversity” is the second most frequently appearing keyword in the Oslo documents and has a total frequency of 58,2%, which means that it occurs a little more often than once every one and a half page. “Foreign” is the third most appearing word and has a frequency of 26,5 percent. That is almost once every fourth page.

“Weed” is only occurring in the “Park instructions” document, and has a frequency of 5,4 percent, or about once every nineteenth page. “Spontaneous” only has a frequency of 0,4 %, with only 1 registration in in the three documents analyzed. This means that the word only occurs once in about 250 pages.

Table 4: Frequencies of keyword occurrences in Oslo documents

		Action plan biodiversity (p.45)	Park instructions (p.22)	Supervisor urban design (p.99)	Total	Ω	Ω %
Type	Weed	0	9	0	9	0.05	5.4%
Descriptive	Spontaneous	0	0	1	1	0.004	0.4%
	Invasive	0	0	0	0	0.00	0%
	Foreign	34	8	2	44	0,26	26.5%
Action	Maintenance	35	107	0	142	0.85	85.5%
Effect	Biodiversity	81*	10	6	97	0.58	58.4%

p. is the number of pages in each document.
Ω is the frequency of how often the different words appear per page.
Ω% is the frequency showed in percentage.
*The title of Oslo’s “Action Plan for Biodiversity” includes the word “biodiversity” three times in the margins of each page throughout the document. I subtracted three times the number of pages the document has (135 registrations) from the total number of registrations I found (216). The result is written with an asterisk symbol in the table.

Based on table 3 and 4, it seems that Berlin overall has mentioned all the specific keywords more often than Oslo.

"Maintenance" is mentioned almost 5 times more often in Berlins documents (Ω418%), compared to Oslo's documents (Ω85,5%). "Biodiversity" is a commonly used keyword for both cities, and even though the total occurrence of the word is more than three times more often used in the Berlin documents, versus the Oslo's documents (317 vs 97), the frequency percentage shows that the keyword is occurring almost twice as often in the Berlin documents (Ω106% vs Ω58,2%).

Berlin also has a total of 51 occurrences of "Foreign", which makes it the third most frequent word in the documents with 17 percent. In Oslo's documents, the word "Foreign" has a total of 44 occurrences, but because of the fewer number of pages in the Oslo documents, this gives a much higher frequency than Berlin, and gives a frequency total of 26,5 percent.

Even though "Foreign" has higher frequencies in the Oslo documents, "Invasive" has no occurrences in the Norwegian documents at all.

The Berlin documents has few registrations of the word "Invasive" as well, with a total frequency of 7 percent. "Spontaneous" also has few registrations in both cities' documents and has a total frequency of 6% in Berlin, and 1,8% in Oslo. The word "Weed" has a frequency of 17 percent in the Berlin documents, which is about three times more frequent than 5,4% in the Oslo documents.

The total length of the different documents summarized varied between the two cities. While Berlin has a total of 298 pages, the Oslo documents only has a total page number of 166. There was also a difference in content between the cities. While the German documents were focusing on green structures and concrete management, the Norwegian documents were mostly covering biodiversity, political park instructions and overall urban design, and there was no request for future development of green structure plans.

3.2 Keyword ranking

When it comes to ranking the positive, negative, and neutral appearances of the different keywords in the respective documents, there is an overall positivity in all the Berlin documents (table 5). There is only one keyword that is ranked as "negative" in all of the documents, and that is the word "invasive" represented in "Berlin Good Care Handbook". There is not a big focus on invasive species in the document, but it explains that specific invading species such as *Solidago, Tanacetum vulgare* and *Impatiens glandulifera* are combated to avoid loss of biodiversity (SenUVK, 2017).

In the "Berlin Strategy for Biodiversity", "invasive" is ranked as "neutral" because the document explains that there are few invasive species in Germany overall, and that invasive species are removed if they are at risk of harming the biodiversity (SenStadtUm, 2012).

There are only two more examples of a keyword that is ranked "neutral", and that is "maintenance" and "weed", both represented in the "Berlin Good Care Handbook". The context research show that the handbook in general has a positive attitude towards spontaneous vegetation and explains that it is up to the intentional look to decide whether spontaneous vegetation shall be implemented. This goes hand in hand with maintenance as well, where the context explains that maintenance is to keep the facility tidy and not overgrown (SenUVK, 2017). The rest of the occurring words in the different Berlin documents has been categorized as "positive" because it appears that Berlin wants to embrace natural vegetation if it is not invasive, because it contributes to biodiversity. Maintenance is not avoidable, but not necessarily done to remove the spontaneous vegetation, but to prevent succession going too far. Maintenance is also done with an overall focus on preserving wild nature, and increases ecological, climate friendly and biodiversity friendly design (SenUVK; 2017; SenStadtUm, 2012; SenUVK, 2020).

Table 5: Keyword ranking for the Berlin Documents

	Berlin Strategy for biodiversity	Berlin Good Care Handbook	Berlin Urban Green
Weed	N/A	○	N/A
Spontaneous	●	●	N/A
Invasive	○	●	N/A
Foreign	●	●	N/A
Maintenance	●	○	●
Biodiversity	●	●	●

The Oslo documents appear to be more neutral to negative to the overall keywords that was searched for (Table 6). In overall, the "Action plan for Biodiversity" and "Park Instructions" stresses the need to remove foreign species, and maintenance are meant to avoid heavy establishment of weeds and foreign species.

Biodiversity on the other hand, is appearing as something positive, but none of the documents describes biodiversity as something that is accepted to happen naturally through spontaneous vegetation, which Berlin does. The documents rather want to make sure that "the right plant is put at the right place". In the "Supervisor for urban design», the keywords «foreign» and "spontaneous" is ranked as neutral, because the words are used in another setting that is not relevant for vegetation, but about social settings(Oslo Kommune, 2023; Bymiljøetaten, 2023; Plan- og bygningsetaten, 2019).

Table 6: Keyword ranking for the Berlin Documents

	Oslo Action plan biodiversity	Park Instructions	Supervisor Urban Design
Weed	N/A		N/A
Spontaneous	N/A	N/A	
Invasive	N/A	N/A	N/A
Foreign			
Maintenance			
Biodiversity			

3.3 Document analysis, Berlin strategies

Berlin strategy for biodiversity

The aim of the "Berlin Strategy for Biological Diversity" is to strengthen the functions of Berlin's green spaces in their historically grown diversity and at the same time to expand the scope for natural development as much as possible (SenStadtUm, 2012, p. 23).

This document describes different methods to promote biodiversity in an urban and modern metropole. It has a goal to spread awareness about the importance of biological diversity (SenStadtUm, 2012).

The "Berlin strategy for biodiversity" it is stated that the city's focus is not only about maintaining the original, unaffected nature, but also about the human made culture landscapes and the urban environment (SenStadtUm, 2012).

There are many habitats in Berlin. For example, poor grasslands, peatlands, urban parks, tree avenues and urban wastelands. The habitats are important for preserving the rich diversity of animal and plant species, but the register for threatened species shows that many of Berlin's species are threatened. The "Strategy for biodiversity" document explains that this is most likely caused by the poor shape of the threatened species habitats. There is therefore needed a big effort (SenStadtUm, 2012).

Foreign species are generally accepted in Berlin but are monitored in case they are affecting threatened species and habitats. Furthermore, the strategy mentions that there are few species that are categorized as
"invasive species", because there are rather few species that affect biological diversity (SenStadtUm, 2012).

Based on this, the strategy further explains that they monitor at which extent the impairments are significant and relevant for action. The actions are not dependent on the extent of possibly negative effect alone, but also of which other goods are affecting:

> *"For example, it is more likely that the presence of alien species in areas that are of particular importance for biological diversity will give rise to regulatory measures than the occurrence of these species in areas that are less valuable in terms of nature conservation"* (SenStadtUm, 2012, p. 12).

A problem is then expressed in "The Strategy plan", actions often are initiated when the respective invasive species have successfully established and are practically retrievable. The shortage of financial and human resources also makes them harder to combat. The "Strategy plan" therefore explains that actions should only be carried out if it seems like there is a possibility of sustainable success (SenStadtUm, 2012). This can cause immediate positive effects for people too because the opportunity to experience nature in an immediate living environment contributes to the wellbeing of the residents. Higher proportions of ecologically active

areas will also improve urban climate and air quality which will in turn contribute to this wellbeing (SenStadtUm, 2012).

Another aim Berlin has is to protect the population of species that are typical in cityscapes. New communities often develop in cities, and many species from different areas establish. Communities like this are generally accepted as well-adapted for urban landscapes. Some of the species that are typical for cities today have emigrated from special locations in the natural landscape and have colonized in cities as important secondary habitats (SenStadtUm, 2012). Examples of urban plant communities are species that grow on walls and buildings, but buildings are often renovated with seamless construction, which results in loss of habitat for these species. Berlin therefore wishes to develop concepts and prioritized measures to handle this (SenStadtUm, 2012).

Berlin is positive towards brownfields wilderness, where unplanned and unforeseen landscapes and natural processes takes place without human interference (SenStadtUm, 2012). "*Current environmental psychology research shows that city dwellers enjoy urban wilderness just as much as traditional green spaces*" (SenStadtUm, 2012, p. 22).

"The strategy" then explains that the acceptance of wilderness can also be increased through cautious measures such as careful development or keeping subareas open (SenStadtUm, 2012). "*For aesthetic reasons, but also for reasons of biotope protection, it therefore makes sense to allow permanent wilderness development on some areas, which can also lead to habitats for highly endangered species (e.g. green toad)*" (SenStadtUm, 2012, p. 22) Biodiversity can often develop in surprising abundance, and depends on landscape design, usage, and maintenance. The historic parks and old cemeteries are particularly important habitats for many species. There are also many wild plants that grow alongside cultivated plants in yards, gardens and on green roofs (SenStadtUm, 2012).

Urban wastelands have also proven to be suitable for natural development. The "Schöneberg southern area" is a model area that is recognized internationally as exemplary and illustrates how undisturbed wilderness-development can cause preservation of open landscapes (SenStadtUm, 2012).

Public recreational and green areas are common in the cityscape of Berlin. These are essential places for natural development, and many are significant in terms of cultural heritage or garden art. The biological diversity often develops here in a surprising abundance, depending on the design, maintenance, and usage of the area. Old cemeteries and historical parks are particularly important habitats for lots of species (SenStadtUm, 2012).

As well as public spaces, Berlin also has a goal to significantly increase the proportion of natural developed landscapes in private open spaces, such as gardens in front of houses, inner courtyards, facades, and roofs. The city has also made incentives to increase the biodiversity on business buildings (SenStadtUm, 2012).

Open, urban landscapes have a rich biodiversity and are kept open. By reusing parts of former traffic areas such as Tempelhof and Tegen airports. The airfield and railway areas are now public spaces that can be experienced by visitors, and offer great natural quality (SenStadtUm, 2012).

Vegetation alongside roads is prioritized in the "Berlin Strategy for biodiversity".

The amount of street trees are part of the reason why Berlin is imaged the "greenest metropole in Europe" (SenStadtUm, 2012). However, the situation of today still offers a numerus starting point for further improvement. Many districts in Berlin have street cross-sections that are generous enough for it to be considered scope for natural development on median strips, on the edge of sidewalks and on tree sections (SenStadtUm, 2012). "*Biological diversity can develop here through self-greening but can also be actively promoted by sowing attractive meadow and border species*" (SenStadtUm, 2012, p. 25).

Figure 9: Tree covered in spontaneous vegetation in Berlin

Berlin Good Care Handbook

Aim: The "Berlin Good Care Handbook" is a strategy plan with an aim for "conservation and promotion of the biodiversity in Berlin" (SenUVK, 2017).

The quality requirements for Berlins green and open space maintenance are formulated and considered recreational use, environmental protection and garden artistic aspects and heritage. The requirements are tailored to Berlins situation and included in the "Good Care Handbook" for all vegetation-related areas with standards of care.

There is an overview guide for taking care of different landscapes. Each chapter has a different type, with a description of look, explanation of the functions of the area type, description of qualities, estimated care-intensity and maintenance goals, explanation of care measures and quality category, indication of special ecological maintenance instructions, summary, and description of potential consequences of not maintaining (SenUVK, 2017).

The "Handbook" has a list of different facilities that allows spontaneous vegetation in different scales. It also includes guidelines for maintenance frequency for each facility:

Street trees (tree openings):
Street trees are tall, single trees in a dedicated street. They are usually deciduous, planted regularly on both sides of the street. They have an aesthetic function, but also fulfill an ecological function as biotope and corridors that connects other green spaces. They also create ecosystem services such as absorbing carbon dioxide, creating oxygen, binds dust, and increase the humidity as well as decrease the heat through evaporation and shade (SenUVK, 2017). According to the "Good Care Handbook", maintenance of green structure under trees is based on different design, but maintenance should happen at least two times in a year. If spontaneous vegetation is implemented in the design, both native and non-native species should be accepted (SenUVK, 2017).

Tree openings can be a micro habitat. "The handbook" states that if spontaneous vegetation is adapted to the surrounding environment, it can be tolerated, otherwise should planting or sowing be with native species (SenUVK, 2017).

Flower beds and medians:
Medians represent garden areas with perennials, grasses, ferns, bulbs and tubes, individual roses, or ornamental shrubs. Its design has an aesthetic and social function, as well as an ecological function if native perennials are used.

Perennials supply different insects, bees, butterflies, and bumblebees that specialize in the different species. Which also gives ecosystem services (SenUVK, 2017).

The handbook states that spontaneous and invasive wild plants in medians and flower beds must be removed
frequently. The wild invasive plants should be removed as early as possible. Otherwise, they will disturb the wanted, planted vegetation, and create “holes” with open soil in the flower bed at a later stage (SenUVK, 2017).
Weeding is usually done before the plants are planted. The frequence of maintenance is dependent on the different plants used in the bed, soil conditions and weather, but happens when one can distinguish blooming wild herbs and culture plants (SenUVK, 2017).

Figure 10: Not all facilities are accepted with spontaneous vegetation in Berlin

Ecotone landscapes

In the transition areas of two biomes that meet and integrate, a third biological community occurs: ecotone. With characteristic strip shape, structure and rich biodiversity, ecotones can be found in the zone between grassland, paths, wooded areas, or water biotopes (Rafferty, 2021).

The ecotone landscapes are often developed through self-propagation. The local conditions enable different compositions of vegetation, with a variety of shapes and colors and results in a variety of habitats environmental resources which specialize in different fauna species. Creating a landscape with rich species and higher species density than in adjacent areas. Ecotones also provide ecosystem services for climate, air, soil, and water (SenUVK, 2017).

According to Berlins "Good Care handbook", this type of landscape does not need a lot of maintenance, and it is the topography that decides the effort of preservation. The terrain can sometimes be difficult to reach with the equipment needed, or the by maintenance workers personally. Although the frequency of maintenance is minimal, the care effort is still relatively high. Preservation refers to removal of neophytes that are not typical for the biotope, as well as warranty of alternate shade (SenUVK, 2017).

The desired succession stage of a location must be developed or maintained through appropriate care. The goal is to ensure that plant and animal species that are valuable are preserved and promoted in the biotope, since impoverished and ruderalized plants have become typical for the site. Berlin wants a "*species-rich and multi-layered border structure or tall herbaceous areas with pronounced to develop flowering aspects*" (SenUVK, 2017, p.190).

The "Good Care handbook" states that it is necessary to keep parts of the landscape uncut to preserve the local fauna. By keeping areas uncut there will still be habitats where the affected individuals can emigrate.

Invasive neophytes such as *Solidago*-species, and dominant perennials such as *Tanacetum vulgare*, as well as single year species like *Impatiens glandulifera* are combated and pushed back. To avoid the displacement of native biodiversity the spreading of the invasive species is prevented with specific measures (SenUVK, 2017). Control measures shall be carried out up to eight times a year, especially for meadows and riverbanks. High spreading and dominant populations such as *Rubus caesius* must be maintained at least two to three times per year (SenUVK, 2017).

"Berlin Good Care handbook" states that the consequences of not maintaining these areas are enormous. Succession will continue to develop, causing a great species loss in these biomes. The dominating populations of unwanted species will destroy diversity. Shrubs and woody growth will displace species and leave the area in permanent shade. Water bodies can become overgrown and even silted up, and habitats and refuges for fauna will disappear.

The loss of this landscape will be difficult to recover, and will use enormous amounts of resources (SenUVK, 2017).

Unpaved areas:

Landscapes with sparse growth of wild herbs. They often appear in cities, such as in unsealed parking lots, beaten paths or on fallow land. There is a big variation in the species compositions that develop in these areas, depending on the nature of the soil, nutrient and water supply and other natural factors (SenUVK,2017).

Unpaved areas don't have many functions, but they are often used as short-cuts or paths. They also perform important ecological functions to the city-scape because it is a succession area and is a slightly disturbed spontaneous vegetation development area. Rare species can thrive along with common species.
New urban societies with spontaneous vegetation are developed with both native and non-native species (SenUVK, 2017).

"Berlin Good Care" describes maintenance of unpaved areas based on two categorizes:

1. Preserved areas
2. Areas planned for further development

The preserved areas usually have a biotope that is wanted to be preserved, so succession must be stopped by removing the growth. While areas planned for further development should be maintained with minimal effort, because of its future development. Care and maintenance should have little focus on species composition, but rather promote wanted structures. Ecological processes and new compositions of species should be accepted (SenUVK, 2017).

Figure 11: Unpaved parking lot in Mittet, Berlin

Berlin Urban Green

Aim: The charter has a purpose to ensure access to green areas for residents, contribute to environmental justice and create an attractive and high-quality environment in Berlin (SenUVK, 2020).

The charter "Berlin Urban Green" describes the city's commitment to developing and preserving urban green areas as an integral part of urban development in Berlin and promotes biodiversity as an integral task throughout the city and is targeted through planning of green and open spaces, roofs, and facades (SenUVK, 2020).

The charter specifies that brownfields should be considered in the implementation of biotope network areas (SenUVK, 2020). Further, the "Charter for the Berlin Urban green" states that brownfields are important for biodiversity and are considered as a temporarily part of the networks of green spaces and biotopes, if the brownfields are not intended for other uses, they are permanently included in the concepts (SenUVK, 2020). In the charter "Berlin Urban Green" it is also informed that economic aids for maintenance and care of green spaces have been reduced the past decades, and further explains the importance of allocating sufficient resources to deal with growth, climate change and usage requirements (SenUVK, 2020).

Figure12: Brownfield in urban Berlin

3.4 Document analysis, Oslo strategies

Oslo Action Plan for Biodiversity

Aim: Protect, restore, and improve the condition of the biodiversity in Oslo (Oslo Kommune, 2023).

The "action plan for biodiversity in Oslo" is made because nature values are under pressure with a need of stronger efforts to take care of the biodiversity, which is considering species diversity, genetic-diversity, and habitat diversity. The plan describes planned measures that will strengthen Oslo's nature qualities (Oslo Kommune, 2023).

The action plan for biodiversity lists challenges that affect the diversity richness in Oslo as encroachment and fragmentation of natural areas, cultural landscape overgrowth, establishment and spread of alien species, increased use of nature areas and pollution of waterways and the fjord (Oslo Kommune, 2023).

In many of the cultural- or natural landscapes in Oslo, alien species have eliminated the valuable natural vegetation, and during the last 20 years, there have been discoveries of new alien plant diseases that kill different deciduous trees and threatens important biodiversity. Oslo has more alien problem-species than any other municipality in Norway and is also the municipality with the highest number of threatened species in the country. Which gives the city a big responsibility to protect the biodiversity (Oslo Kommune, 2023). In 2023 there were 1354 species that were categorized as at risk of extermination in Oslo. 487 of these species are not detected after the year 1980. The "Action Plan" speculates if this may be because they are already extinct from Oslo. 35 of these species are also considered extinct in the whole country. There are no other municipality in Norway that appears to have had a biodiversity loss in such a degree (Oslo Kommune, 2023).

"The action plan for biodiversity" blames degradation of landscapes, spread of invasive species and climate changes for the increasing loss of biodiversity (Oslo Kommune, 2023). As a part of the maintenance and care goal in the "Action Plan", Oslo wants to strengthen the administration of valuable nature reserves and cultural landscapes, this includes important biological environments. They also want to combat alien species. At the same time, themunicipality also wants to preserve the biodiversity by facilitating more wild nature and pollinator friendly plants in the city's parks and public areas and strengthen the excising measures to combat alien invasive species through prioritizing effort against more species and in more locations in the city.

Further on, the municipality also wants to create a status report of threatened species. The report will create a base for safeguarding, reconstruction, and possibility of reintroduction of populations of threatened species (Oslo Kommune, 2023).

Park Instructions

Aim: The Urban Environment Agency (Bymiljøetaten) who has written the "Park Instructions", has a goal to make a "Safe, beautiful, green and active city" (Bymiljøetaten, 2023).

The "Park Instructions" purpose is to give instructions to both interns and extern projects regarding parks and open spaces that is managed by the Urban Environment Agency (Bymiljøetaten, 2023). This document gives instructions and sets requirements for design and functionality for all park facilities managed by Oslo's Park administration.

The instructions ensure both new and upgraded facilities in parks and open spaces are planned, prepared, and delivered in operation and that future care is ensured (Bymiljøetaten, 2023).

The "Park Instructions" document classifies park facilities into four categories: "destination park", "local park", "nature park" and "activity park", and pinpoints what is typical for each category (Bymiljøetaten, 2023). None of the parks are categorized with spontaneous vegetation, but nature parks are mentioned as facilities with low complexity and little facilitating (Bymiljøetaten, 2023).

In the "Park Instructions" document, there is also mentioned the importance of well-planned planting in new projects:

> *"Oslo is Norway's most species-rich municipality, but also has the largest number of species on the Red List for species and on the Alien Species List, which means that natural diversity is threatened in many places, among other things due to the influence of foreign species" (Bymiljøetaten, 2023, p. 20).*

There are also occurrences of threatened nature types that the municipality describes having a national responsibility to look after, such as open shallow calcareous ground, limestone- and rich deciduous forests and grassland (Bymiljøetaten, 2023).

The "Park Instructions" further explains that well-planned vegetations will increase biodiversity, prevent establishment of unwanted species and add identity and uniqueness to a place, and create positive experiences for the residents of Oslo (Bymiljøetaten, 2023).

In areas without a lot of people, or with steep slopes or little residence, the "Park Instructions" suggest establishing lawns, which are mowed two to three times a season. Flowering meadows are only mowed once in the late summer. This makes them vulnerable to perennial weeds because the weeds get plenty of time to establish (Bymiljøetaten, 2023). However, meadows with native vegetation have a rich biodiversity and are important for many species. In elevated pedestrian areas or demarcated beds, well protected from trampling, the "Park Instructions" explain that perennials are well suited, while shrubs can be a choice to include to shade out weeds (Bymiljøetaten, 2023).

Supervisor for Urban Design

Aim: To inspire how to design the urban landscape with local and sustainable measures (Plan- og bygningsetaten, 2019).

This is a supervising document for urban design in the built landscape of Oslo and gives guidelines to ensure a strong urban character with qualities that facilitate for wanted city life (Plan- og bygningsetaten, 2019).The "Supervisor for Urban Design" describes how urban nature must be implemented and restored in areas where nature is missing, and how the density of development must not come at expense of natural or man-made natural diversity (Plan- og bygningseataten, 2019).

> *When densifying and renovating urban areas that are characterized by hard surfaces and the absence of nature, we must help to restore this. In denser parts of the city, we must make greater use of rooftops, city walls and street floors to establish new urban nature and green surfaces that compensate for the lack of green space* (Plan- og bygningsetaten, 2019, p. 87).

Figure13: Spontaneous vegetation in urban Oslo

4. Discussion

This research was aiming at finding how green structure approaches towards urban spontaneous vegetation in current city plans in Berlin and Oslo, and to find the background of their choice. This chapter will therefore be comparing the results I have collected in the different cities plans and discuss the findings with other literature.

4.1 Aims, keyword ranking and strategies in contrast

The overall aim for the Berlin documents can be summarized as a wish to expand natural and wilderness in urban development areas, conserve biodiversity and ensure green access and high-quality environment for the residents (SenStadtUm, 2012; SenUVK, 2017; SenUVK, 2020). The term "wilderness" can be perceived synonymous to "spontaneous vegetation". While the overall aim of the Oslo documents to design the urban landscape with local and sustainable measures, make a safe, attractive, green, and active city and to give instructions regarding parks and open spaces (Plan- og bygningsetaten, 2019; Oslo Kommune, 2023; Bymiljøetaten, 2023). None of these aims gives an impression towards the city's approach of urban spontaneous vegetation.

Based on the summarized document aims, one can imply a positive approach towards urban spontaneous vegetation in Berlin, while Oslo's aims give a "zero finding" regarding their approaches towards urban spontaneous vegetation. To get a clearer understanding of the different cities' approaches, I will therefore have to look further into the structure of the different documents analyzed, through this discussion chapter.

The keyword rankings overall imply that Berlin is more positive towards all the keywords that were searched for, while Oslo in overall were more negative to neutral. The strongest positive result that stuck out was "Biodiversity" for Oslo. Although the biodiversity aspect tends to be more linked to a *native* species rich diversity, rather than an *overall* species rich diversity, which is what Berlins ranking implies.

4.1.1 Colonization of invasive species

Even though the keyword registrations and document analysis lead to a zero-finding result regarding approaches towards urban spontaneous vegetation in the Oslo documents, one can be quick to conclude that this implies a general negativity towards urban spontaneous vegetation, although that does not have to be the case. Even though the documents did not mention urban spontaneous vegetation approaches at all, the "Oslo Action plan for Biodiversity" was still mentioning relevant information that is linked to spontaneous vegetation: invasive species. Oslo stresses the importance of combating invasive species because of the threat they contribute to the potential extinction of native species, and states that the municipality has a national responsibility to protect the biodiversity in the city, because Oslo has more foreign problem-species than any other municipality in Norway (Oslo Kommune, 2023; Bymiljøetaten, 2023).

This gives Oslo a big scale perspective on risks and spread of invasive species, where a total elimination of the invasive species is the ideal situation. This does not mean that all spontaneous vegetation must be considered as something negative by Oslo, but since spontaneous vegetation often comes with foreign and invasive species, the municipality puts the focus on combating unwanted vegetation. The "Action Plan for Biodiversity in Oslo" even mentions that they want to facilitate more wild nature (Oslo Kommune, 2023), and the "Park Instructions" even recommends establishing biodiversity-rich meadows in areas with few people, steep slopes or little residence (Bymiljøetaten, 2023).

In comparison, Berlins "Strategy for Biodiversity" states that they show acceptance towards spontaneous vegetation based on the level of threat the species may cause the native fauna, and that they rather face actions if the spontaneous vegetation contains threatening species that can affect an important habitat for biological diversity (SenStadtUm, 2012). This gives an indication that Berlin considers the pollination of vegetation to cause *local* effects.

Wind-pollinating invasive species has a high resistance- and spread rate and a tendency to have more seeds, which increases the success rate of colonization (Chen et al., 2021). Spontaneous vegetation therefore causes a higher potential risk of settlement than indigenous species. The foreign and invasive species are also very often established through help of human activities like traffic and house gardening (Chen et al., 2021; Sikorska et al., 2021). Which can be a good argument to support Oslo wanting to erase all invasive species.

In one way, one can ask if the acceptance towards urban spontaneous vegetation, hand in hand with Berlin's aims to be a green and biodiverse city with ensured access to green areas for residents (SenStadtUm, 2012; SenUVK, 2017; SenUVK, 2020) can lead to corridors or steppingstones of patches that makes it easier for invasive species to spread their seeds all around the city (Thompson et al., 2015; Winkler et al., 2024).

Research by Gao et al. (2021) done in Kunming city in South-west China, a hotspot for biodiversity that has been heavily affected by urbanization over the past decades, studied the plant richness of spontaneous vegetation in urban green structures, and compared the occurrence of indigenous, foreign, and invasive species. Their result showed that 77,2% of the species where native, while 17,9% of the vegetation was invasive, and 4,9% were foreign but not invasive.

To minimize the number of invasive species, bigger patches of green structure is necessary, but Gao et al. still promote the use of spontaneous vegetation in smaller patches and corridors to conserve natural species richness in urban landscapes (Gao et al., 2021).

The recent study by Gao et al. (2021) confirms that urban, heterogenic environments covered in spontaneous vegetation still offers a considerable amount of biodiversity, and that species of spontaneous vegetation can be used advantageously in urban environments because of the little demands of care and maintenance, as well as their positive adaptive characteristics making them suitable for reconstructed habitats (Gao et al., 2021) This study therefore confirms Kühn's (2006) perception of urban spontaneous vegetation having an environmental value, being suitable for ornamental purposes, and requiring low maintenance intensity (presented in chapter 1.1.2 "Messy is attractive as long as it is tidy").

It appears that Berlin follows the arguments that Kühn (2006) and Gao et al. (2021) has presented: That spontaneous vegetation is creating a biodiverse environment and is therefore accepted. Furthermore, the "Berlin Strategy for Biodiversity" mentions that there are few species that are categorized as "invasive species", because there are rather few species that affect biological diversity (SenStadtUm, 2012).

Berlin therefore chooses to monitor the invasive species, and do not take actions on the possibility of negative effects alone, but also consider what goods the actions can cause (SenStadtUm, 2012). Berlin is therefore focusing on preserving the species that is important for nature conservation. Which means that rare and threatened species are more prioritized than normal and non-threatened species (SenStadtUm, 2012).

Figure 14: Spontaneous vegetation in ornamental setting in

4.1.2 Spontaneously or designed biodiversity?

Based on the keyword ranking of the word "biodiversity", both Oslo and Berlin show a positive approach towards biodiversity in general but looks at biodiversity through different spectacles.

While "Oslo Action Plan for Biodiversity" describes how landscape encroachment and fragmentation, overgrowth, establishment and spread of alien species and pollution as factors that have negatively impacted the declining species' richness. The municipality points to alien species as the reason for the elimination of valuable natural vegetation (Oslo Kommune, 2023).

They therefore want to combat alien species, while they at the same time want to preserve biodiversity by facilitating more wild nature and pollinator friendly plants in the city's parks and public areas (Oslo Kommune, 2023). This is reflective in recent landscape architecture projects in the city.

The Scandinavian landscape architecture company "SLA architects" finished a large masterplan for Bjørvika urban spaces in 2023 (SLA, n.d.). The district of Bjørvika used to be an old industrial area and was a busy traffic area, with a highway passing through the whole site (Bjørvikautvikling, n.d.a). The new development of the district had goals to be a cityscape with high quality, and one of the sub goals was to be an environmentally friendly district that strengthens the biodiversity (Bjørvika, 2013). The area is 700 decare and was developed with 40% housing development, 40% parks and promenade and 20% infrastructure (Bjørvikautvikling, n.d.b).

There was made an "overall environment follow-up program" that explains that the district of Bjørvika will most likely not be able to establish a rich biodiversity, but that it would still facilitate a variated vegetation suitable for birds and animal life, as well as aesthetic values (Bjørvika, 2012).

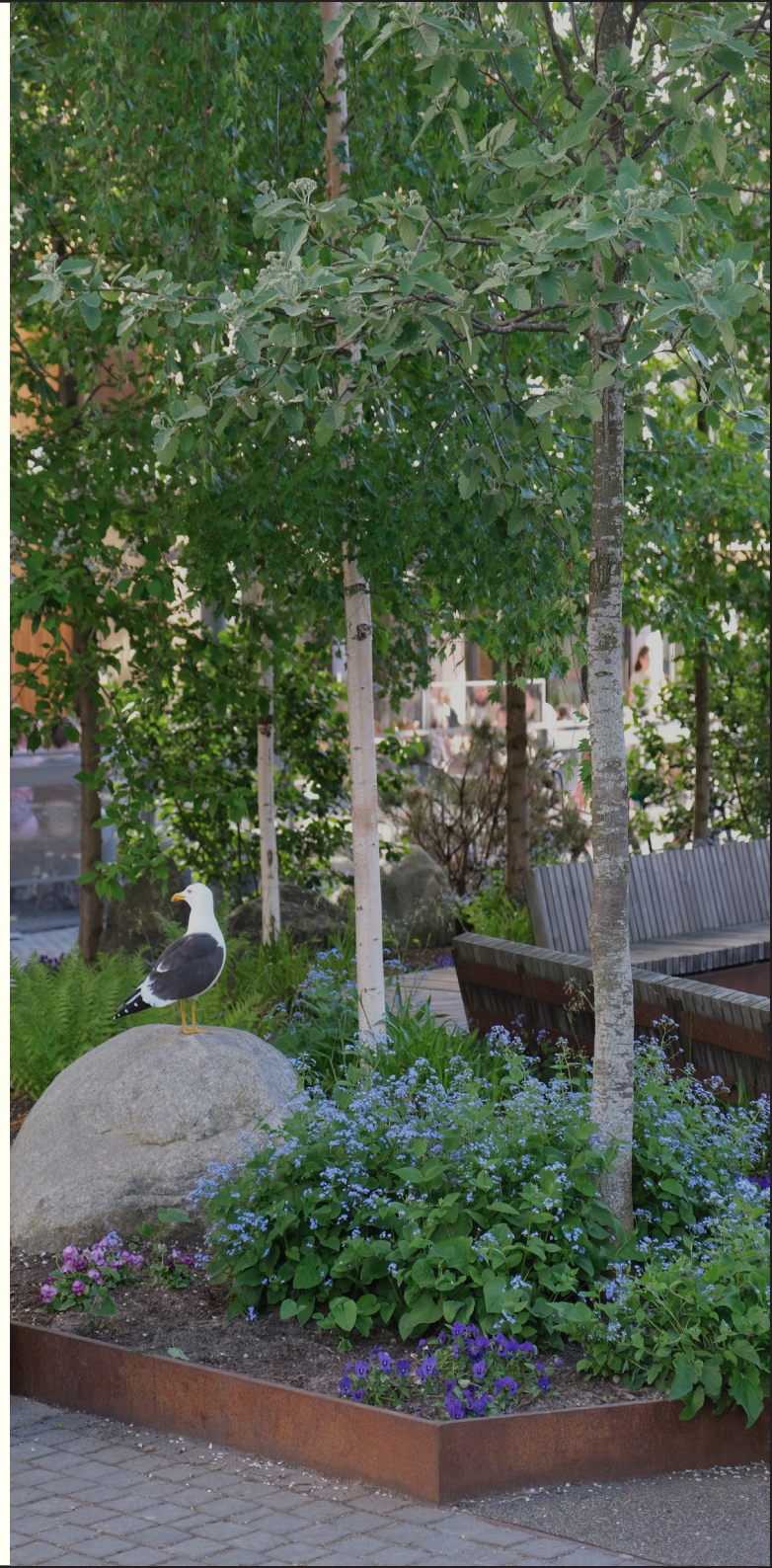


Figure 15: Bjørvika is aesthetically facilitated with vegetation suitable for birds

The latest "Annual report for environment and sustainability" was published in 2023 and confirms that Bjørvika's developed with a rich diversity of vegetation. The vegetation used in this project reflects typical species that can naturally be found in the wildscapes of Oslo, and invasive species are avoided (Bjørvikautbyggingen, 2023).

The vegetation is therefore carefully chosen and well planned before putting in its spot. The development of Bjørvika district shows how Oslo is working towards biodiversity and a naturalistic landscape through design, instead of letting natural succession establish independently, which shows that the masterplan has followed the "Supervisor for Urban Design", that describes that nature must be implemented in landscapes where nature is missing, such as areas with hard surfaces (Plan- og bygningsloven, 2019).

Figure 16: Bjørvika's rich diversity is designed

Figure17: Bjørvika, Oslo

In comparison, the “Berlin strategy for biodiversity” document explains that they want to protect typical cityscape species because they are considered well-adapted to the urban landscape and the city have sat a goal to promote urban wilderness (SenStadtUm, 2012), and the charter “Berlin Urban Green” also consider brownfields as a biotope, since they are valuable for the biodiversity (SenUVK, 2020). This implies a big acceptance and inclusion towards nature that is considered as valuable, especially whenneglected environments are considered valuable.

The Nature-Park Südgelande in Berlin is created on a former railway yard in Berlin. Almost 5 centuries of natural succession have transformed the industrial landscape into a natural urban wilderness (Langer, 2012). This park is acknowledging the spontaneous growth of vegetation, and what could be perceived as a neglected area is instead appreciated.

History plays a big role in the development of the nature-park. The railway was shut down after the second world war, but when Berlin was split into east and west by the Berlin Wall, the management over the railway was controlled by the east, even though the site was on the territory of the west. Which left the area closed for human interference and got gradually covered in wildness. After the Berlin Wall fell, and the city developed rapidly, there was need of ecological compensation. The rights of the Südgelande were sold from the railway company to the state of Berlin. Due to the immense diversity of flora and fauna, the area proved to be the most valuable ecological area in Berlin. To protect this ecology, and still make it open to the public, approaches were made (Langer, 2012).

The central part of the park was categorized as a “nature conservation site”, while the rest of the park were categorized as “landscape protection site” (Langer, 2012).

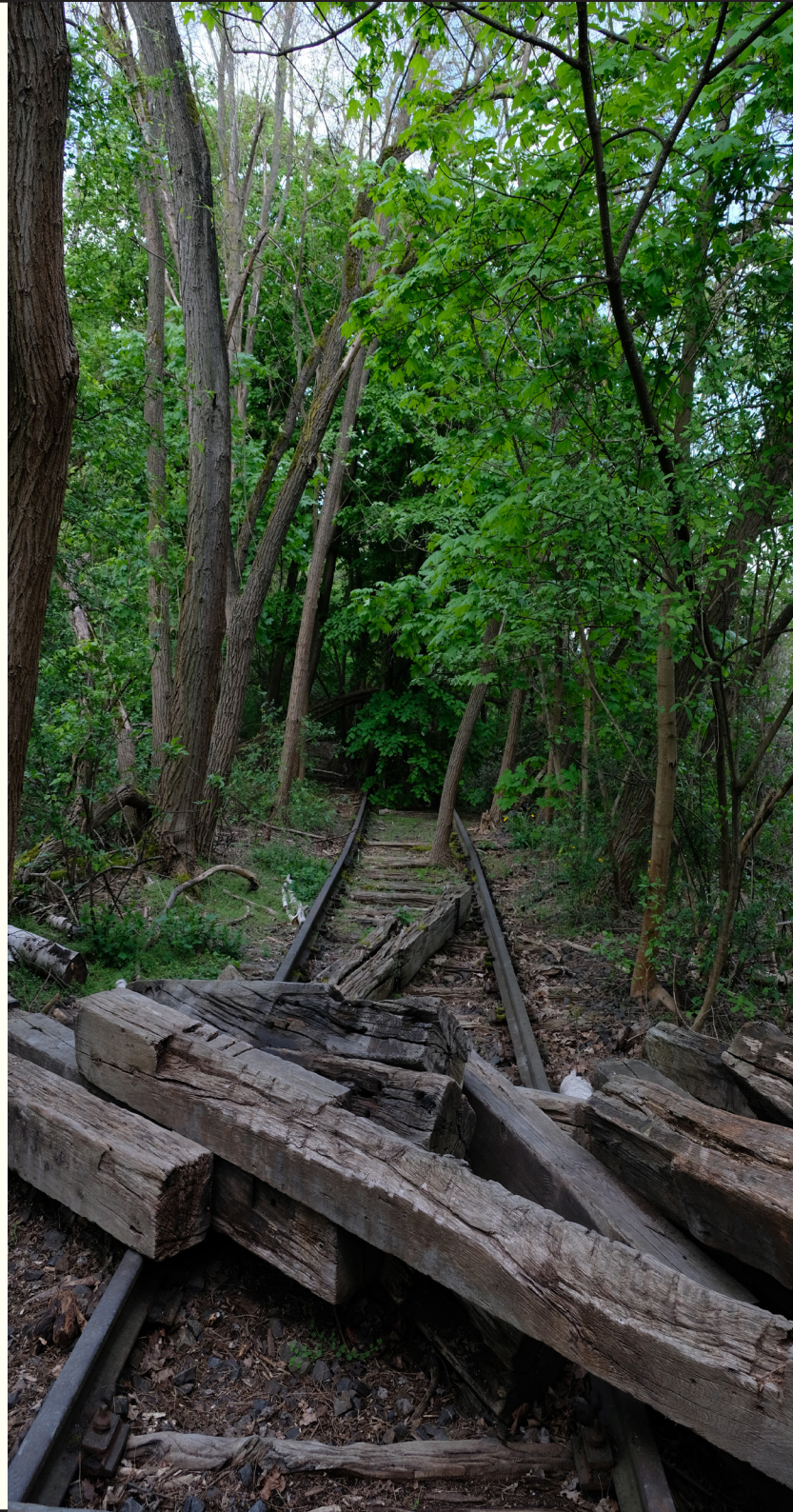


Figure 18: Remainings of the old railroad in park Südgelande

Vegetation surveys showed that the ongoing succession would lead to complete reforestation within a short time. This would further mean that the characteristic species and plant communities of open landscapes would decline, as well as loss of spatial diversity (Kowarik & Langer, 1994). There was therefore decided to "*combine both natural dynamics and controlled processes*" (Langer, 2012 p.155).

The park was defined in three landscape types: woody strands, clearings, and groves, where woody strands would be left unfettered, clearings were kept open and light and open stands were maintained as groves (Langer, 2012).

Figure 19: Ongoing maintenance in park Südgelande

To preserve the ecology a path system following the linear structure of the railroad was developed in the "landscape protection site", while a raised walkway was provided in the "nature conservation area". The walkway was elevated 50cm above the vegetation, so it does not impact the vegetation and natural succession (Langer, 2012).

The park opened for the public in 2000 (Langer, 2012). Since then, the natural dynamic acceptance has evolved into a new factor as part of the design concept: management and vegetation growth. The wild woods are kept unfettered, but trees and shrubs in the groves are cut down from time to time, while highly invasive species like *Robinia pseudoacacia* and *Populus tremula* are prevented in the clearings. Sheep also grazes a few days in early summertime in the clearings. Sheep has a selective habit when grazing, so they help maintain a diverse and wild-like structure on the vegetation (Langer, 2012).

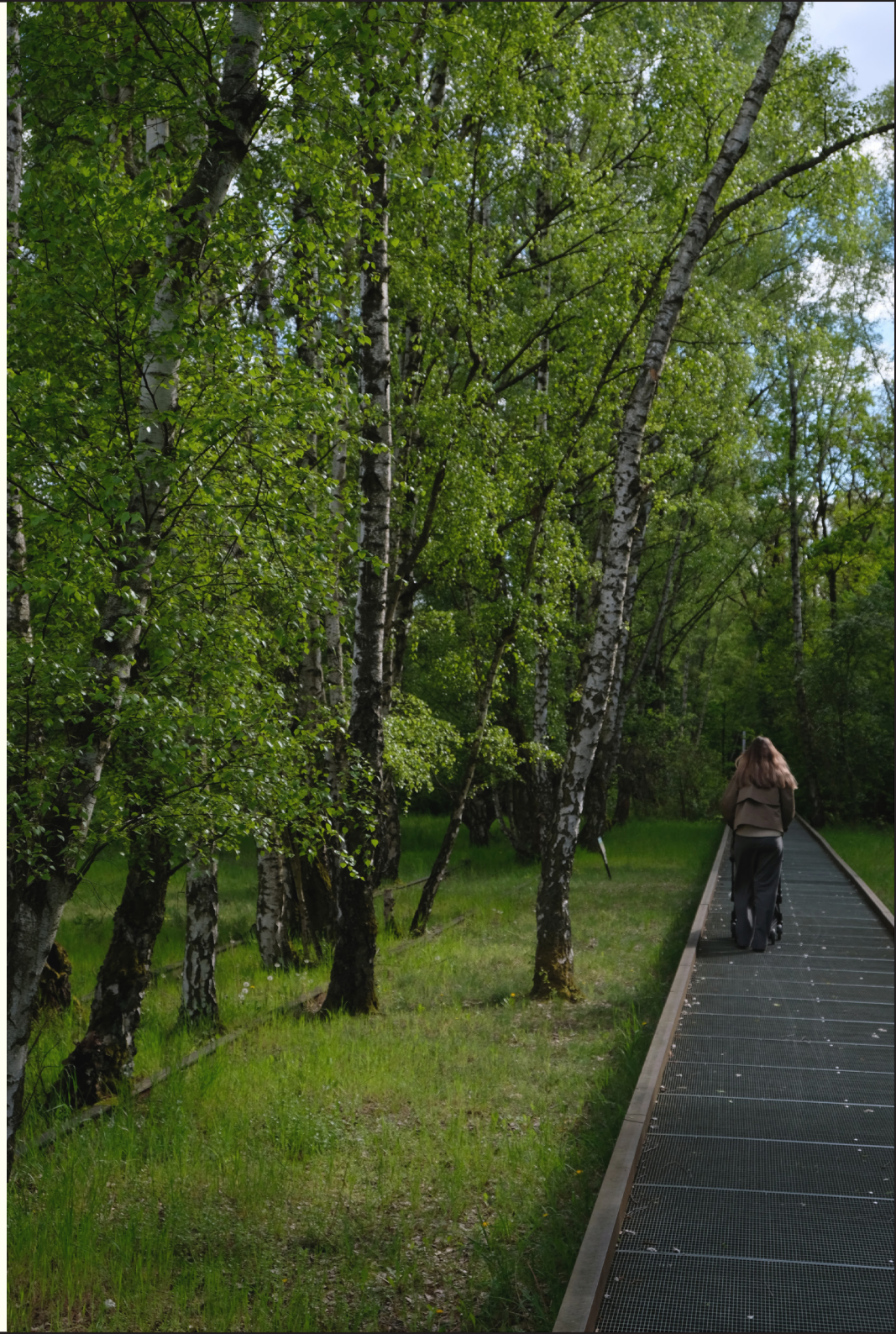


Figure 20: Raised walkway above protected, spontaneous vegetation

Figure 21: Nature-Park Südgelande, Berlin

It might be questionable to compare a brand-new district development in Oslo with an existing nature park in Berlin. The reason behind the choice of case studies is to underline the different focuses in each city. Both cities had examples of industrial areas that were transformed, but while Berlin chose to let the spontaneous vegetation and natural succession establish and implement designed elements to make it a public park, Oslo redeveloped the Bjørvika site and made an urban district with both residential, cultural, social, and work-friendly environment. The vegetation was carefully chosen to match the local, native, and natural vegetation that enrich the biodiversity.

This describes two approaches towards the same goal, with different methods. On the other hand, housing demands may play a crucial role in the development planning process. As Brynildsrud's (2022) study shows, Oslo has prioritized urban development higher than conservation of nature within the city zone, which is a valid choice in a city where and the demand of housing development in the city is higher than the supply (ESA, 2023).

One can also interpret that Oslo is not considering undesigned vegetation as enjoyable, based on the description in "Park Instructions", that explained that "good use of vegetation will create good living spaces, and add identity and uniqueness to a place, and create positive experiences for the residents of Oslo" (Bymiljøetaten, 2023). Bjørvika still contributes to biodiversity with designed patches of biotopes, which can help the connectivity of species spread (Winkler et al., 2024).

The development of Südgelande happened because of ecological compensation after the rapid development of the city (Langer, 2012), which indicated that there were still land available for development in the early years of 2000, and recent documents also confirms that there still is sufficient land available for development to this day in Berlin (Langer, 2012; SenSBW, 2023).

4.1.3 Spontaneous vegetation, too hard to manage?

In Oslo's "Action Plan for Biodiversity", they state they want to facilitate more wild nature, and still combat alien, invasive species (Oslo Kommune, 2023). The problem with designing "wild" landscapes, is that in order to be truly wild, foreign and invasive species will most likely follow.

To create a natural-looking landscape does not mean that the vegetation will be robust enough to withstand the self-introduction of foreign and invasive species. Even though studies from Gao et al. (2021) show that there might be a overweight of indigenous species in urban green spaces, Oslo has a big challenge combating invasive species already, which means that unwanted species will continue their establishment in a potential spontaneous vegetated landscape (Chen et al., 2021; Sikorska et al., 2021; Butchart et al., 2010; Ruas et al., 2022). It is therefore crucial to include a plan for maintenance that describes the frequency of how often *all* facilities should be maintained in an urban environment (Czortek & Pielech, 2020).

Especially in a city like Oslo, that stresses the unwanted invasion of foreign species. It would still be interesting to do a test project with buffer zones of nitrophilous tall herbs and shrubs around valuable nature, based on the results from Čepelová & Münzbergovás (2012) study.

In Berlins maintenance document: "Good Care", the handbook explains that street tree openings, ecotone landscapes and unpaved areas are all typologies where spontaneous vegetation can be accepted to an extent (SenUVK, 2017). The handbook has made overviews of how often the different facilities in Berlin needs maintenance. For example, are facilities like flower beds and medians maintained more frequently than facilities that are accepted with spontaneous vegetation, because they are supposed to be free from spontaneous- and invasive plants.

4.1.4 Different strategies towards the same goals

Both Berlin and Oslo seem to work towards the "Sustainable Development Goals" from the United Nations, but has different strategies to follow the goals. Goal 15.5. describes that there should be taken urgent and significant actions to minimize the degradation of natural habitats, stop the biodiversity loss, and prevent and protect threatened species from going extinct (UN, 2015).

Berlin's method seems to be a way of letting spontaneous vegetation grow in different facilities (SenStadtUm, 2012). Oslo seems to avoid the spread of spontaneous vegetation and focuses on developing green structures planted with indigenous species (Bjørvika, 2012; Bjørvika, 2013; Bymiljøetaten, 2023).

The cities also follow goal 15.8, that explains that measurements to prevent introduction and reduce impact of invasive and foreign species on land and water significantly, and to control priority species (UN, 2015).

While Berlin is monitoring the invasive species in different facilities, and take actions based on the goods it can cause, Oslo avoids foreign and invasive species overall. Mainly because of the threat they cause to the indigenous flora (Bymiljøetaten, 2023; Oslo Kommune, 2023). Berlin does not have many threatened or threatening species (SenStadtUm, 2012).

Overall, both cities follow goal 15.9 stating that values for ecosystem and biodiversity should be integrated in local and national planning and development processes (UN, 2015).

Figure 22: Trees on a balcony in Berlin

4.1.5 Delusions of cost-effectiveness

Even though many studies have claimed that including spontaneous vegetation is cost-effective because of the natural species establishment (Deparis et al., 2023; Farruggia et al., 2022; Fischer et al., 2020; Kühn, 2006; Sikorska et al., 2021), the charter "Berlin Urban Green" informs the importance of allocating sufficient resources to deal with growth, climate change and usage requirements, and also informs that economic aids for maintenance and care of green spaces have been reduced the past decades, and that maintenance is necessary to improve the green space's value (SenUVK, 2020). It is questionable if maintenance expenses really are reduced. Even though the facilities may not need to be cared for as often as a cultivated green structure, and the acceptance towards spontaneous species in general are higher, it also indicates that the expertise of the care-personnel needs to be high to be able to selectively know what kinds of invasive species must be removed.

In cities like Berlin, where invasive species are not a big problem, it might not be as difficult to spot the unwanted vegetation, which also means that the maintenance might not have to be very as frequent. In a city like Oslo, where many species are already threatened and invasive species are a challenge, maintenance may be more expensive, especially if the frequency of maintenance is high. Maintenance is also important in order to prevent succession going too far (Kühn, 2006).

The research by Fischer et al. (2020) and Nassauer (1995) also shows that the population in general prefers green structures that has a tidy appearance. This means that city dwellers will have to plan carefully to make sure the city does not look neglected, but aesthetic and biodiversity friendly.

A good example is therefore to implement spontaneous vegetation in urban areas that could benefit from green structures and are accessible for maintenance workers. Tram lines has proven to be a ideal urban biotope (Winkler et al., 2024).

4.2 Data collection challenges

To conduct this research, I had to collect city documents from two different countries, which led to some challenges because of the language barrier, and because the variation in documents for each city. Finding documents from Oslo was more time-consuming compared to Berlin, mainly because there were no general plans created with an overview of maintenance of green structures, like Berlin had.

There were also difficulties when registering the occurrence of the different keywords in the different documents that were translated into English. The total number of occurrences were therefore not completely matching up in the documents translated from German to English and from Norwegian to English. Even though synonyms were searched for as well. There can therefore be information that potentially is lost in translation in the document analysis.

The keyword ranking (**positive** – **neutral** – **negative**) showed a big contrast between Berlin and Oslo, with a lot more positivity in the German documents. Since I had trouble finding similar documents to analyze, this might have given mis informational impact of Oslo's approaches towards urban spontaneous vegetation. The Berlin documents suited the research well.

Another challenge was to make sure that the frequency of keywords was relevant for my topic when I analyzed the different documents. For example, "maintenance" is a very broad word that can describe care and conservation of vegetation, but it could also describe renovation of buildings and infrastructure. I had to go over the registrations to find what context the different keywords were used and was in that way able to eliminate 227 occurrences of the word "care" in "Berlin Good Care Handbook", as well as eliminating 135 occurrences of the word "Biodiversity" in Oslo's "Action Plan for Biodiversity" (ref. table X and table X).

The keyword "Maintenance" is mentioned almost 5 times more often in Berlins documents (Ω 418%), compared to Oslo's documents (Ω 85,5%). The explanation to this is because Berlin has a guideline for maintenance of different green structures of the urban landscape, while that is not the case in Oslo.

The nonexistence of a maintenance document can also lead to a questionable approach towards Oslo's handling of spontaneous urban vegetation. One can speculate if lack of maintenance guidelines might possibly lead to neglected care of different green structures that is not in a specific, designed facility in Oslo. In that case, these green structures may inadvertently contribute to growth of spontaneous vegetation.

5. Conclusion

There is a contrast in available documents that regard urban spontaneous vegetation in Berlin and Oslo. While Berlin had well-suited documents for the analysis, while it was hard to find relevant documents from Oslo in general.

Based on the documents analyzed, I will answer research question 1: **What green structure approaches towards urban spontaneous vegetation can be found in current city plans in Berlin and Oslo?**

The Berlin documents were concise about their approaches in their documents. The plans explain what type of facilities they allow spontaneous vegetation in, and that they have a general acceptance towards foreign species. At the same time, they monitor invasive species, and do not take actions on the possibility of negative effects alone, but consider what goods the actions can cause. They also looked at all green structures as part of biodiversity, even neglected brownfields.

Berlin has a dedicated green space management plan that explained how frequent facilities should be maintained.

The Oslo documents had a lot less findings overall. The documents did not mention any specific approaches towards urban spontaneous vegetation, but they put a big focus on reducing the amount of foreign and invasive species, as they are threatening many native species in Oslo. Further, the Oslo documents gave an indication that urban green spaces should be designed and planned instead of spontaneously evolving, and that the use of species should be indigenous. The Oslo documents had little to no detailed information about general facilities and maintenance needs.

How can we understand the background of their choice of green structure approach?

The background of the approaches is understood to be linked to the threat level the different cities are experiencing towards invasive species. Oslo is the city in Norway with the highest number of invasive species, and they therefore consider it a national responsibility to protect the vulnerable native vegetation. Oslo is also under a development pressure, with little land available. Since smaller patches of vegetation has a higher amount of invasive or foreign species, and indigenous species has a higher risk at surviving in bigger patches (Gao et al., 2021). It is therefore a safe choice to avoid spontaneous vegetation in the urban areas of Oslo.

In comparison, Berlin is threatened by few invasive species, and do not need to put a big effort in combating foreign or invasive species in their green structures. Berlins historically neglected brownfield-areas may also lead to a natural acceptance of spontaneous vegetation by the residents in the city, which means that there is a cultural acceptance towards urban spontaneous vegetation in green structures. The city does also have sufficient land available for future construction developments. Which gives the city more room for spots of spontaneous vegetation.

Figure 23: Spontaneous vegetation can be appreciated by insects

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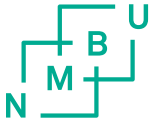
Appendix

Table 7: Complete registration table for Berlin documents including English and German Searches

	Berlin Strategy for biodiversity (p. 47)	Berlin Good Care Handbook (p. 227)	Berlin Urban Green (p. 24)	Total	Ω	Ω %
Weed (EN)	0	51	0	51	0.17	17%
Unkraut (DE)	0	59	0	59	0,20	20 %
Spontaneous (EN)	1	16	0	17	0.06	6%
Spontane (DE)	1	16	0	17	0,06	6 %
Invasive (EN)	3	19	0	22	0.07	7%
Invasiv (DE)	3	17	0	20	0,07	7%
Foreign (EN)	22	29	0	51	0.17	17%
Fremd (DE)	22	29	0	51	0,17	17 %
Maintenance (EN)	131	1091*	25	1247	4.18	418%
Pflege (DR)	97	1048*	25	1170	3,93	393 %
Biodiversity (EN)	221	79	17	317	1.06	106%
Biodiversität (DR)	221	84	17	322	1,08	108%

Table 8: Complete registration table for Berlin documents including English and Norwegian Searches

	Action plan biodiversity (p.45)	Park instructions (p.22)	Supervisor urban design (p.99)	Total	Ω	Ω %
Weed (EN)	0	9	0	9	0.054	5.4%
Ugress (NO)	0	9	0	9	0.054	5.4%
Spontaneous (EN)	0	0	1	1	0.004	0.4%
Spontan (NO)	0	0	1	1	0.004	0.4%
Invasive (EN)	0	0	0	0	0,000	0 %
Invasiv (NO)	0	0	0	0	0,000	0 %
Foreign (EN)	34	8	2	44	0,265%	26,5%
Fremmed (NO)	33	8	2	43	0,259	25,9%
Maintenance (EN)	35	107	0	142	0,855	85,5%
Vedlikehold (NO)	30	91	0	121	0,729	72,9%
Biodiversity (EN)	81*	10	6	97	0,584	58%
Biodiversitet (NO)	81*	10	6	97	0,584	58%



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