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Horticulture and Crop Production Science**

Designed plant communities for challenging urban environments in southern Finland

- based on the German mixed planting system

Sara Seppänen

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Supervisor: Karin Svensson, SLU, Department of Landscape Architecture, Planning and Management

Examiner: Jitka Svensson, SLU, Department of Landscape Architecture, Planning and Management

Co-examiner: Anders Westin, SLU, Department of Landscape Architecture, Planning and Management

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SLU, Swedish University of Agricultural Sciences
Faculty of Landscape Architecture, Horticulture and Crop Production Science
Department of Landscape Architecture, Planning and Management

Abstract

Traditional perennial borders require a lot of maintenance and are therefore not so common in public areas in Finland. There is a need for low-maintenance perennial plantings that can tolerate the dry conditions in urban areas. Especially areas close to traffic, such as the middle of roundabouts and traffic islands need easily manageable vegetation and they are therefore normally covered in grass or mass plantings of shrubs. Well-designed plant communities require less maintenance than lawns and are more biodiverse and visually interesting than mass plantings. In the 1990s a Mixed Planting system was developed in Germany, with perennial mixes for public plantings and since then over 30 different mixes have been trialled and tested. The mixes were created for a specific habitat and can be used in different areas with that same habitat. However, the German climate is different from the Finnish and the mixes cannot therefore be used as they are. The Finnish climate is looked into with a focus on urban climate to get an understanding of what is required of a plant to survive in these conditions.

The thesis looks into the difference between traditional horticultural perennial plantings and designed plant communities, such as the German mixed plantings.

In this thesis four of the German perennial mixes are redeveloped to suit urban conditions in Southern Finland. The mixes from the German mixed planting system that were developed further are; Silbersommer (Silver summer), Filigran (Filigree), Präriemorgen (Prairie morning) and Blütenmosaik (Flower mosaic). The species that are not hardy in the Finnish climate or not available on the market in Finland were substituted for species that are hardy and available. The mixes that were created contain a varying amount of the original species and have been given new names: Kuohu, Kaino, Onni and Kaiho.

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Background

The horticultural approach to planting design has mostly been to fit the site to the plant and not the other way around. Is it not logical that the key to a successful planting would be to choose plants that fit the conditions in which we want to plant them?

Growing conditions are often harsh in urban settings and there is often lack of water, excess heat and poor soil conditions for plants to grow in. The conditions are different inside an urban area to the climate outside of it, due to human activity. Urban public plantings are often designed with a strict budget but often with poor results and plantings close to infrastructure, such as the middle of roundabouts or strips between car lanes, are tricky and dangerous spots to maintain and manage and often considered not worth spending much money on. These spots are normally covered with mass plantings of low shrubs or grass, since such plantings can be managed as a whole and are inexpensive to design. However, mass plantings can be uninteresting to look at and certainly lack biodiversity. Other tricky spots are under big trees, they are often bare because the tree roots are taking all the water and the canopy is shading the area. An option for these kinds of environments is mixed perennial plantings, with plants chosen to thrive in the given habitat. An established well-designed plant community requires less maintenance than lawns and creates a more interesting and diverse environment that is sustainable and resilient.

In Finland, public plantings are dominated by woody species and annual plantings, perennials have been used mostly in central parks with intensive maintenance (Tuhkanen & Juhanoja, 2010). I believe that there is a need for low-maintenance perennial plantings without compromising the looks of the planting. In the 1990s a Mixed Planting system was developed in Germany, with perennial mixes for public plantings and since then over 30 different mixes have been trialled and tested (Bds, 2019b; Oudolf & Kingsbury, 2013). The mixes are developed for different habitats and they also have visual themes, colour being the most common one. Designing dynamic ecological plantings requires a lot of plant knowledge and can be quite time consuming. Instead of having to start from the beginning every time, the ready-made mixes such as the ones developed in Germany, save money already in the design phase.

Aims and limitations

The aim of the project is to come up with suggestions of mainly herbaceous plant combinations for hypothetical conditions that represent challenging urban environments in southern Finland. An example of such an environment could be; well drained, sunny and nutrient poor conditions. The task is to find plants that thrive in such conditions. The research question is:

Which plant combinations can be used to get dynamic herbaceous long-lasting plantings in challenging urban habitats?

The plants chosen will be based on German perennial mixes, taking into account another geographical context and therefore different climate, which in this case is southern Finland. The work will only consider planted mixes, not seed mixtures. No plant combinations will be planted or tested during this thesis work, due of lack of enough time to implement such a large investigation and due to the character of a master thesis (30 credits). The mixes will not be designed for specific locations but could rather work as a tool for choosing species for similar environments. Rain gardens

and green roofs are not considered in this thesis and neither are park-like environments. The focus is on dry planting areas close to traffic.

Method

Literature study

This thesis is mainly a literature study, that uses the German Mixed Planting system as a base for creating similar mixes that suit challenging urban conditions in southern Finland. The literature study includes explanations and thoughts on different terminology regarding designed plant communities and looks at the ecology and dynamics of plant communities. The German Mixed Planting system is discussed and in the end some of the German mixes are chosen to be developed into mixes for the challenging urban conditions explained in this thesis. To understand why the German mixes cannot be used as they are, a section regarding the Finnish climate and growing conditions is included. The difference between urban and rural climate is also looked into briefly.

The references used in this thesis consists of books on ecological planting design, general planting design and plant ecology. Articles on the same matters and also on urban climate have been read to further understand the subjects discussed in this thesis. The Finnish climate conditions are based on data from the Finnish meteorological institute. There is not a lot of literature about designed plant communities or dynamic planting design, but it is becoming a more popular subject to write about. A large portion of the literature is about naturalistic or ecological garden design, there are only a few books that I found that consider mainly public plantings. The search of literature was limited to four languages, English, German, Swedish and Finnish. Examples of search words used are: ecological planting, dynamic planting, naturalistic planting, designed plant community, urban habitats and mixed planting.

Creation of plant mixes

The mixes are chosen based on their habitat description, the ones that are meant for dry open spaces and dry half-shaded areas are looked further into. The species in the German mixes that are not hardy in the Finnish climate are substituted for hardy species that are suitable for the specific habitat. The substituting species are chosen with the help of Finnish literature, to make sure the plants are hardy and otherwise suitable. The result will be four plant mixes; plant lists with ratios, flowering charts and some general management measures.

The mixes from the German mixed planting system that will be developed further are: Silbersommer (Silver summer), Filigran (Filigree), Prärieмorgen (Prairie morning) and Blütenmosaik (Flower mosaic). The mixes are developed further, because they are not fully suitable for Finnish conditions as they are. The first step is to look at the species list and recognise the plants that are not suitable for Finnish conditions. For this, Finnish literature and Finnish nursery plant lists are used. The second step is to exchange these plants with species that are hardy in southern Finland and that fulfil the same task in the mix as the original species. For example, if a species from the emerging perennials is not hardy enough it is replaced by a hardy species that still functions as an emerging perennial. This way the balance of the community stays intact. Some of the species in the original plant list have an alternative species that could replace the first option. In the cases where the alternative species is hardy in Finland and the first

option is not, the alternative species is chosen for the new mix. In the case where neither the first option or the alternative species is hardy, a new one is chosen. Figure 1 explains this further.

Standort: *trocken, gut durchlässig, Problemstandort* **Licht:** *sonnig* **Farbe:** *v.a. blaue, weiße u. gelbe Blüten, silbriges Laub*
Anwendungsgebiete: *u.a. Verkehrsbegleitgrün, Parks, Wohnungsbau, Hausgarten; Mindestgröße der Pflanzfläche: 30 m²*
Pflege: *bodennaher Komplett-Rückschnitt im Spätwinter vor Austreiben der Zwiebelpflanzen, individuell Rückschnitt des Festuca*

Silbersommer
Artenliste und Charakteristik

Name (botanisch - deutsch)	Stück/100 m² (empfohlener Mengenanteil)	Hinweise (W: Winterwirkung durch Strukturen und Texturen oder wintergrüne Belaubung)	Alternativart/-sorte
1. Gerüstbildner			
Achillea filipendulina 'Coronation Gold' Gold-Garbe	20	*silbergraues Blattwerk, gelbe Blütenscheiben ab Juni bis Oktober, [W]*	
Festuca mairei Atlas-Schwingel	10	*monumentales Horstgras, dünne, elegant überneigende Halme, [W]; Rückschnitt im zeitigen Frühjahr individuell auf 15 - 20 cm*	*Panicum virgatum ‚Heavy Metal' (straff aufrecht, grau-grünes Laub, gelbe Herbstfärbung) oder Calamagrostis x acutiflora ‚Overdam' (panaschiertes Laub)*
Perovskia abrotanoides Perovskie, Blauraute	10	*weißfilzige Triebe und Blätter; lange blaue Blüte im Sommer, Halbstrauch*	
Phlomis russeliana Brandkraut	10	*wintergrüner Blattteppich, langlebige Struktur durch mehrstöckige Blüten- (gelb, ab Juni) und Fruchtquirle [W]*	
Sedum telephium 'Herbstfreude' Purpur-Fetthenne	25	*rotbraune Blütenteller im Spätsommer, Bienenpflanze [W]*	*S. ‚Matrona' (rötliches Laub)*
Stipa calamagrostis ‚Algäu' (Syn. Achnatherum calamagrostis) Silber-Ährengras, Alpen-Raugras, Föngras	10	*straff aufrechtes Gras, locker überhängende Rispen, legen sich vorübergehend nieder, schöne Wirkung von Juni bis Februar [W]*	*Stipa calamagrostis ‚Lemperg' (reichblütig, rötliche Herbstfärbung)*
Verbascum bombyciferum Seidenhaar-Königskerze	10	*markante Gestalt, langblühend, zweijährig, versamt sich, wenn genügend offene Stellen vorhanden [W]*	*V. chaixii ‚Album' (ausdauernd)*

Figure 1. This is the top of the plant list for the German mix Silbersommer. In the left-hand column you can see the plants in the mix. Some of the species in the list have an alternative species suggested in the right-hand column. For example, if Festuca mairei is not hardy or unavailable in Finland, the next step is to look if some of the alternative species suggested are hardy and available.

Since the mixes are designed with traffic areas in mind, some of the taller species are replaced for smaller ones.

The reason why the German Mixed Planting system is used as a base, is that it is one of the few and probably the best developed and researched dynamic perennial planting styles that exists to this day and it would be unwise not to take advantage of the information that is available, when looking for new plant combinations. Southern Finland was chosen because I see myself working with projects in this area during my professional career. Additionally, the population density is largest in the south of the country and the area is quite urbanised. In figure 2 the method is visualised.

Structure

This thesis is divided into 6 parts; first the introduction, which you are reading now, where the background and method of this thesis is explained. The second part is about designed plant communities, introducing some essential terminology and the ecological processes behind plant communities, the third part focuses on designing dynamic plant communities and also introduces the German mixed planting system. The fourth part is discussing growing conditions, specifically in southern Finland and urban conditions and in the fifth part the perennial mixes are created and presented. The final part, the discussion and conclusions discusses and summarises the findings and present some suggestions on further development.

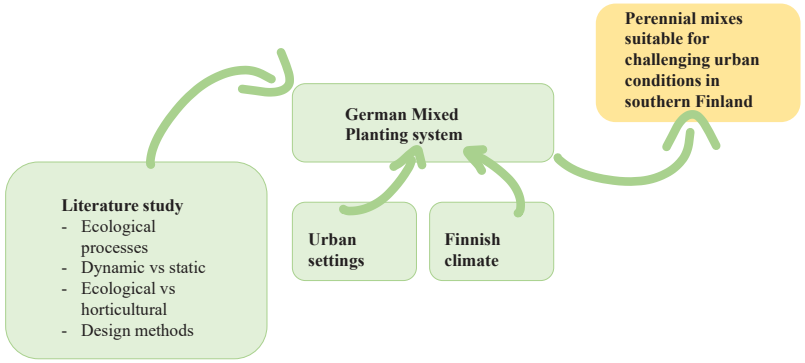


Figure 2. The steps of the work

2 Designed plant communities

Brief history on ecological plantings

Terminology

Dynamic and ecological versus static and horticultural

Native versus exotic

The ecological processes of a plant community

- Grime's Plant Strategy Theory (CSR theory)
- Competition and co-existence between plants

Biodiversity

Management and maintenance

Sociability

In this part of the text the ideas behind designed plant communities are explained. The text is based mainly on chapters from the 2004 book *The Dynamic Landscape: Design, Ecology and Management of Naturalistic Urban Planting*, edited by Nigel Dunnett and James Hitchmough. The ecological processes are primarily based on the theories of ecologist J. Philip Grime. Other central literature referred to are *Planting in a post-wild world: designing plant communities for resilient landscapes* by Thomas Rainer and Claudia West from 2015, *Planting – a new perspective* by Piet Oudolf and Noel Kingsbury from 2013 and *Perennials and their garden habitats* by Richard Hansen and Friedrich Stahl from 1993.

Brief history of ecological plantings

Even though some might still refer to ecological plantings being a new planting style, the idea dates back at least some 200 years (Woudstra, 2004). The ecological principles and ideas were there, even though they were not always called that. Already in 1805 Alexander von Humboldt wrote in his book *Essai sur la géographie des plantes*, that based on his observations plant communities from different parts of the world, but in similar latitudes, resembled one another (Woudstra, 2004).

The first ecological plantings were designed for botanical gardens. Woudstra (2004) explains, that since around the year 1800 onwards two types of approaches to ecological planting have formed, one being the plant geographic approach and the other being the physiognomic approach. The geographic approach aims to replicate a type of vegetation specific to a geographical region, whereas the physiognomic approach strives for a natural character, pattern and functioning of the vegetation without looking at the geographic origin of the plants in the composition (Woudstra, 2004).

In the beginning of the 20th century, in some areas, such as Germany, "ecological planting was used to reinforce nationalism" (Woudstra, 2004, p. 53) and then became unpopular after the Second World War. However, it was in 1948 that Richard Hansen founded the Institute for perennials, shrubs and applied plant sociology in Weihenstephan, Germany and started exploring different plant combinations for stylised vegetation types (Woudstra, 2004). The results from these experiments over the next few decades were summarised in 1981, when Richard Hansen and Friedrich Stahl published their book *Perennials and their garden habitats* and in 1993 the English translation was released (Hansen & Stahl, 1993). The book categorises perennials in groups according to their suitability for different habitats, such as "the rock garden" etc. The book was ground-breaking because of the way it groups plants according to their sociability and habitat.

Terminology

Dynamic = continuously changing and developing (Cambridge Dictionary, 2019)

Perennial = a plant that lives for several years (Cambridge Dictionary, 2019)

What is a dynamic planting? James Hitchmough and Nigel Dunnett from the Department of Landscape at Sheffield University have defined it as a planting where ecological processes are the key and change and spontaneity are therefore a natural part of the planting (Oudolf & Kingsbury, 2013). What Rainer and West (2015) call a designed plant community, is essentially the same thing.

Ecological thinking in planting design has become so common these days, that the ecological approach is called modern, current (Körner, Bellin-Harder & Huxmannor, 2016) or contemporary (Kingsbury, 2004) planting design.

According to Robinson (2016) plantings that are visually similar to natural plant communities are often referred to as naturalistic. There are many different words for similar kinds of plantings that all have a nature-like appearance compared to traditional or formal horticultural plantings. Dunnett and Hitchmough (2004, p. 12) for example, admit that "the concept of ecologically based plantings is unfortunately a very slippery one, and one that is open to wide interpretation". The most simplified way of looking at what an ecological planting is, is the way in which plants are chosen based on the right plant for the right place (Dunnett, 2004).

According to Dunnett, Kircher and Kingsbury (2004) the biggest difference between naturalistic and ecological plantings is probably that in ecological plantings the focus is on maintaining them to **function** like nature whereas in naturalistic plantings, the focus is on maintaining them to **look** like nature. Dunnett (2004, p.100) states that, "many so-called ecological approaches to landscape planting tend to emphasise the visual connection with naturalistic vegetation rather than the underlying processes going on in that vegetation". Understanding these processes is the key to being able to create diverse and species-rich plantings.

Dynamic and ecological versus static and horticultural

How is a designed plant community different from a "regular" perennial planting? The perennial border is the kind of public and private perennial planting that we have become accustomed to. In a traditional horticultural planting the plants are organised by height, so that the tallest plants are in the background and the shorter ones in the front. The plants are chosen based on their looks; their height, colour and flowering time. This traditional way is a remnant from the past, when the working force was large and cheap (Alanko, 2007), and it was therefore not a problem having these labour-intensive plantings even in public spaces. A designed plant comminity focuses more on the ecological processes of a planting and the planting functions as a community and the species are more intermingled (see figure 3).

You could say that all plantings are dynamic because they change just by growing, but that is not what is meant by dynamic in this case. A dynamic designed plant community is not intended to stay at the same stage forever, it is partly free to develop over time with minimal management measures, while still having an aesthetically pleasing look. Traditional horticultural plantings are maintained to look the same way from year to year and change is kept at a minimal level. This of course requires frequent maintenance measures and any species that are not designed to be there are seen as weeds (Morrison, 2004).

Kingsbury (2004) gives an explanation on what kind of plantings can be considered dynamic and which ones are more static in table 1. He sees it as a diagram of nature and art and how they connect in planting design. Most relevant for this thesis is the transition from static to dynamic and what kind of plantings represent these concepts. The German mixed planting system, which forms the base of this work, is located in the middle of the diagram, a dynamic planting of the stylised nature category.

As Oudolf and Kingsbury (2013) point out, monocultural plantings

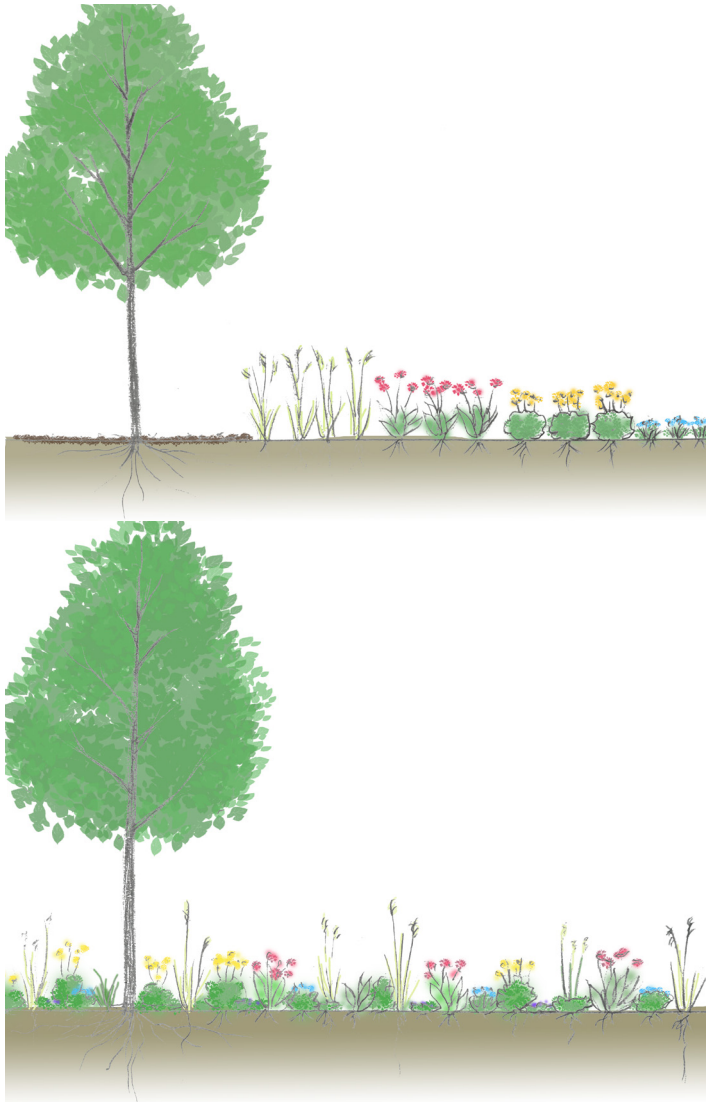


Figure 3. A traditional horticultural planting and a dynamic ecological planting

are easy to maintain since weeds stand out from the mass and are therefore easy to get rid of. More complex plantings are trickier, because more plant knowledge is required to understand which plants are weeds and which are meant to be there. Naturalistic plantings easily hide species that are not necessarily planted intentionally, and therefore might not even become a problem for the planting and can just be left unweeded (Oudolf & Kingsbury, 2013). Naturalistic plantings are also not as vulnerable to having a species "fail" or disappear from a planting as other species will fill the gaps eventually.

In traditional horticultural plantings plants are placed "like pieces of furniture" as Rainer and West say (2015, p. 43), with open soil between the plants. In nature, the soil is never bare, except for in really extreme conditions, such as deserts. Heavy mulching is often used, and the plants are not allowed to spread around or move. According to Rainer and West (2015), a designed plant community should be designed layer by layer, so that the ground remains covered throughout the growing season. The roots of plants also play a role in designing a plant community.

One problem that Rainer and West (2015) point out, is that many plants that would be suitable for designed plant communities are not available on the market, because nurseries and retailers have a hard time selling plants that do not look special. Also larger perennials, that would flower in the end of the summer, do not often succeed to flower in the small nursery pots, making them difficult to sell (Alanko, 2007).

According to Hitchmough (2004, p. 130) "Naturalistic herbaceous vegetation differs from conventional herbaceous vegetation in that it mimics the spatial and structural form of semi-natural

Table 1. A gradient from static to dynamic plantings and the use of native or exotic species. Adapted from Kingsbury, 2004.

		Dominant horticultural influence	Strong horticultural influence	Horticultural and ecological influence	Strong ecological influence	Dominant ecological influence
		Mass planting	**Informal planting**	**Stylised nature**	**Biotope planting**	**Habitat restoration**
Role of natives	Native species only		Conventional garden design with natives	Species selected for visual impact e.g. Amstelveen	Colour-schemed wildflower plantings	Prairies, meadows and other wildflower habitats
	Mixture of natives and non-natives			‘Lebensbereich’ German parks style, German mixed planting system	Native/exotic biotopes e.g. Hitchmough & Dunnett	Woodland with some non-native tree species
	No particular emphasis on natives, but plants with a naturalistic aesthetic used, ie, no doubles or variegation.	Mass perennial planting e.g. much Oehme and Van Sweden commercial work	‘Informal’ garden plantings e.g. Piet Oudolf	’Lebensbereich’ German parks style	Botanic Gardens ’biogeographic planting’	
	Horticultural aesthetic i.e. Includes double flowers, variegation etc.	Conventional landscape design	Conventional garden design			
		Static	→			***Dynamic***

vegetation". By semi-natural vegetation he means meadows and other types of grasslands that look the way they do because of some human intervention like haymaking.

Figure 4 gives an overview of how the amounts of environmental disturbance (maintenance measures) and/or environmental stress (site fertility) affect the outcome of the landscape.

Native versus exotic

One big debate when talking about ecological plantings, is the use of exotic species. Hitchmough and Dunnett (2004) state that native species are somehow automatically believed to be more ecological than exotic ones. Exotic or alien species is not a synonym to invasive species, but of course you must be careful when using new exotic species in an area for the first time. Quigley (2011) also criticises the common belief of natives being better than alien species, he explains that the native plants are taken out of context when they are placed in an urban setting, which means that they do not necessarily perform in the same way as in their natural habitat. Given how much humans have moved and altered the ecosystems around the world, it's hard to even define which species is native or exotic to a specific place. Hitchmough and Dunnett (2004) point out that the supporters of native flora often come from countries where there is a large flora and relatively short history of gardening, such as the USA. Rainer and West (2015) state that the use of natives can be a way of achieving an authentic look for the planting, but they are also supporters of the right plant for the right place idea, not focusing on the geographical origin of the species. All species, no matter their geographical origin, have their ecological niches (Rainer & West, 2015).

The use of exotic species prolongs the flowering period (Hitchmough & Woudstra, 1999), which means that they are important for pollinators, especially in early spring. Dunnett and Hitchmough (2004) discuss that the geographical origin of the plant is probably not as important for biodiversity as is the taxonomic diversity of the planting and the number of different layers created by different plant species. They think that the focus in naturalistic plantings should be on the ecological process, instead of trying to come up with as many native species as possible without much focus on the dynamics of the planting.

According to Hansen and Stahl (1993), some exotic species thrive in a different habitat in the garden than where they originally come from. This is the reason why trialling is important, to get to know the plant in a different climate.

Based on their experience, Hitchmough and Dunnett (2004) suggest that there is misconception regarding sustainability in local authority planning departments, where only native plants are seen as sustainable. Hitchmough and Dunnett (2004) explain that plants that are most biologically sustainable are the ones that are able to procreate and change evolutionary, which means the species can be both native or exotic. Another point is that there are other aspects of sustainability to consider, such as social sustainability. Biologically sustainable plantings are not always socially sustainable (Hitchmough & Dunnett, 2004). When it comes to maintenance and management, the most sustainable plantings are the ones that are designed to be managed as a whole (Hitchmough, 2004).

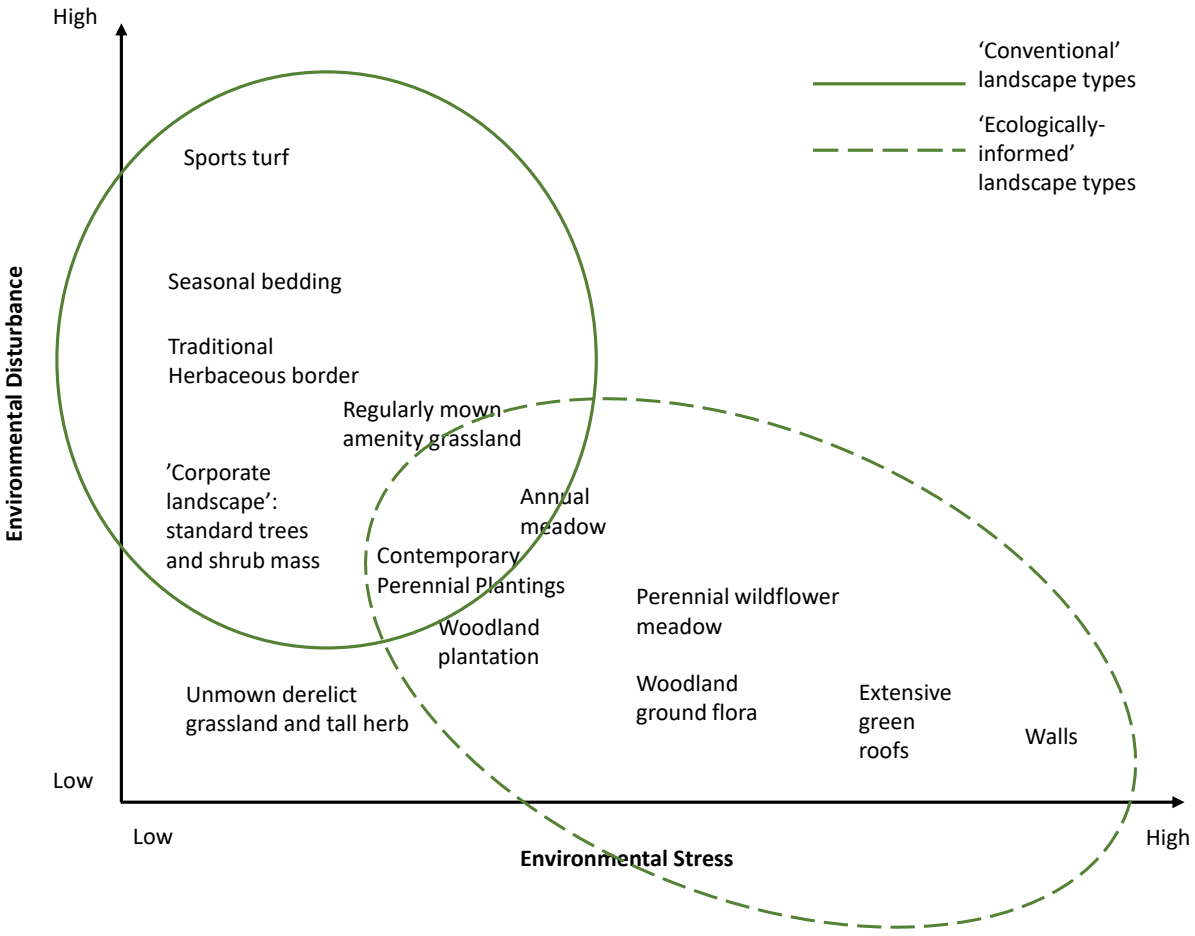


Figure 4. A graph showing the high intensity of maintence and lack of stress being connected to the ”conventional” landscape types. Adapted from Dunnett, 2004.

The ecological processes of a plant community

Grime's Plant Strategy Theory (CSR theory)

There are several different theories about plant survival strategies, but the most well-known according to Dunnett (2004) is ecologist John Philip Grime's CSR-theory. According to Grime (1977) there are two external factors that limits a plants growth; stress and disturbance. Stress is the factors that restrict the production of the plant, such as limited water, light or nutrients and unsuitable temperatures whereas disturbance is the partial or complete destruction of the plant's biomass caused by animals, humans, diseases and natural conditions like wind damage, frost, drought, soil erosion or fire. When comparing these two factors, three plant strategies emerge: Competitors (low stress and low disturbance), stress-tolerators (high stress and low disturbance) and ruderals (low stress and high disturbance), see table 2. Grime stresses that these are extremes and variations of these three exist.

Table 2. The CSR-strategy comprised in a table, recreated from Grime, 1977.

		Intensity of stress	
		Low	*High*
Intensity of disturbance	*Low*	Competitive strategy	Stress-tolerant strategy
	High	Ruderal strategy	No viable strategy

Competitors are fast growing, often tall/big plants that reproduce mostly vegetatively and spread vigorously above and below the ground in favourable conditions without stress or disturbance (Grime, 1977). Herbaceous competitors often have their growing points at the top of the shoots (Grime, 2001), making them strong competitors for light. Examples of herbaceous competitors are *Fallopia japonica* and *Urtica dioica* (Grime, 2001).

Stress-tolerators are mostly slow-growing, long-lived, often evergreen plants that have modest flowers (Grime, 1977). Stress-tolerators put little effort into reproduction. An example of a herbaceous stress-tolerator is woodland species *Lamiastrum galeobdolon*.

Ruderals are short-lived and fast growing and spread by seed or vegetatively. They are mostly annual herbs that produce a lot of seeds. They need disturbance in order to survive, otherwise stronger competitors will suffocate them. Some plants with a ruderal strategy have dormant seeds, that can germinate when a disturbance occurs, and the opportunity presents itself. An example of a ruderal species is *Polygonum aviculare*, an annual herb.

Competition and co-existence between plants

There is some controversy regarding the definition of competition. Grime (2001) criticises the way of looking at it as the life of a plant is a constant struggle, as Darwin said it. Ecologist P.A. Keddy defines competition as: "the negative effects that one organism has upon another, usually by consuming or controlling access to a resource that is limited in availability" (2017, p. 125). Grime's definition is "the tendency of neighbouring plants to utilise the same quantum of light, ion of a mineral nutrient, molecule of water, or volume of space" (2001, p. 12).

Species that take over other species through competition in situations with no constraints are called dominant species (Dunnett, 2004). In fertile conditions, where there is a lack of stress and

disturbance, competitive plants dominate, and a monoculture is likely established (Grime, 2001). By constraints Dunnett means lack of some resource and therefore the key to a diverse vegetation is understanding which constraining factors lead to diversity and choosing plants with matching competitiveness. Grime (2001) discusses that herbaceous plants are able to grow next to one another when there are factors that limit the growth of dominant plants. This means that low stress and disturbance levels lead to dominant species taking over, so in order to get a diverse planting, some stress and disturbance is needed. In gardening terms for example, too much fertilising (reducing stress) and no maintenance measures (reducing disturbance) leads to fierce competitors taking over the planting (Dunnett, 2004). Fertile and moist environments are denser in vegetation, whereas dry and less nutritious sites are more open (Hitchmough, 2004).

Dunnett (2004) summarises the importance of the CSR-theory for ecological planting design into 2 categories: plant selection and vegetation management. Choosing plants from the same strategic group, means that they are suitable for the conditions on site and therefore ensure the long-term survival of the plant community. There are not however many lists of plants based on their survival strategy (Dunnett, 2004), which again emphasises the need of good plant knowledge and ability to recognise in which group a species belongs to. Vegetation management can be seen as designed measures of stress and disturbance. Management measures, such as mowing or grazing are disturbance factors and for example altering the soil fertility or water availability are stress factors.

The changes within a plant community are obviously related to changes in individual plants, such as their growth, reproduction and death, but are also related to changes caused by competition and interaction between plants and the type of vegetation or environment surrounding the planting (Dunnet, 2004). Dunnett presents three different categories of dynamics in plant communities:

- phenological change
- fluctuations or cycles
- successional change

Phenological change is the change undergoing in a plant community during one growing season or year. The growth pattern of a species, meaning for example when they start growing in the spring and when the flowering occurs, during one growing season is called the phenology of a species.

Fluctuations or cycles are the changes of the species in the plant community between different years, but with the character of the whole community still remaining the same. Dunnet (2004) states that there have not been many long-term studies monitoring the cyclical changes of a plant community. The ones that have been made however show that plants usually have good and bad years, mainly depending on weather conditions and many perennials need some kind of rejuvenation after some time.

Successional change is the long-term development of the character and composition of the plant community and type of the vegetation. The difference to fluctuations and cycles is that succession indicates the change of the character, not only the composition of the species, e.g. the change from grassland to woodland.

Biodiversity

It is obvious that a mixed planting with several different species is more diverse than a single-species planting. But in all growing conditions it is not so easy to achieve a diverse composition. Dunnett (2004, p. 104) states that "In general, greatest species diversity is promoted at moderate intensities of environmental stress and/or disturbance". We can understand this based on the CSR-theory; a too fertile and non-disturbed site often leads to a monoculture.

Why is biodiversity important? Dunnett (2004) summarises the benefits of biodiversity in the context of designed vegetation in six points:

1. aesthetics and visual pleasure

Aesthetics and visual pleasure are probably the most obvious benefits. The diversity in colour, form, texture etc. that ecological plantings have, provide visual pleasure throughout the year.

2. stability: removing vulnerability from simple systems

Dunnett (2004) explains that a diverse plant community is more stable than a simple system. If we take a perennial planting as an example, a mixed planting can understandably adapt better to changes than a single-species planting. If the species of a monoculture happens to fail somehow, the entire planting fails, whereas a mixed planting can fix itself, by other species taking over the gaps of the failed species.

3. setting up succession

Ecologically-informed plantings are unpredictable and even though this unpredictability can be difficult to accept, it means that they develop over time ensuring the continuity of the planting in some form.

4. supporting other types of organisms

Diverse vegetation supports a greater variety of other organisms, such as birds and insects, than a less diverse vegetation.

5. filling up available niches

In traditional plantings weeds are plants that grow between the intentionally planted plants. They grow there because there is an available niche. By filling all the available niches from the beginning the amount of weed control is significantly reduced.

6. maximising the length of display: phenological change

Diverse plantings have a variety of phenologies; different flowering times and growing patterns, stretched out along the growing period. This gives a longer visual display.

Management and maintenance

What is the difference between management and maintenance? The difference can be understood just by looking at the words themselves; maintenance has the word maintain included, which means preserve, therefore vegetation maintenance includes measures to keep a vegetation in a certain way. Management on the other hand has the word manage included, meaning to control, which makes vegetation management measures to control the development of the vegetation.

According to Dunnett (2004, p. 112) management operations could be seen as "preventing, promoting or diverting succession", even though they are not commonly described like that. It means that in order to keep for example a meadow as a meadow, it

needs to be cut down regularly in some way, otherwise trees will start growing to form a woodland after some years. In the same way a designed plant community has to be managed to steer the development in the desired direction.

Dunnett (2004) points out that because designers and gardeners are keen to get fast results in terms of plant growth, we have somehow started to believe that plants actually need extremely fertile soil. As we know by now, fertile soil leads to dominance by competitive species, limiting diversity dramatically. To keep a very fertile planting diverse, a lot of management is needed.

Sociability

In addition to the CSR-theory there are other ways of categorising plants. Sociability (or grouping) within a planting is a concept introduced by Hansen and Stahl in their book *Perennials and their garden habitats*. According to Hansen and Stahl (1993) the sociability of a plant depends mainly on its form of growth, but other factors also determine which group they belong to. For example, perennials that die back after flowering are not suitable to be planted in large groups, since they would form empty spots in the planting. Clump-forming perennials, such as *Hosta ssp*., loose some of their character when placed in larger groups, single plants better express their beauty. Based on their knowledge and experience, Hansen and Stahl have grouped perennials into five levels of sociability (see figure 5 as well):

I singly or in small clusters

II small groups of 3-10 plants

III larger groups of 10-20 plants

IV extensive planting in patches

V extensive planting over large areas

(Hansen & Stahl, 1993, p. 41)

The levels of sociability help to understand how the species grow, for example plants in the higher levels of sociability are often groundcovers and plants belonging to group I are well suited as eyecatchers in a planting, since they look best on their own.

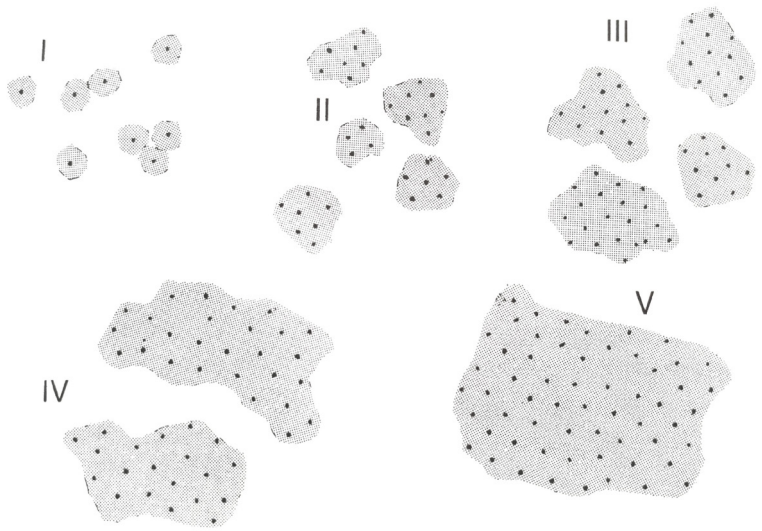


Figure 5. The five levels of sociability. (Hansen & Stahl, 1993, p. 42)

Designing dynamic plant communities 3

Creating layers above and below the ground

Aesthetics/Public perception

Lebensbereich, German garden habitat or the Hansen school

The mixed planting system

- Disadvantages
- The mixes developed so far
- Different applications of the mixes

Development of dynamic plantings and guidelines for them in Finland

- Perennial trials in Finland

Creating layers above and below the ground

Designing dynamic plantings or plant communities is understandably more complex than traditional planting design. There needs to be an understanding for ecological processes and plant knowledge in general, to achieve sustainable plantings. In order to make it easier to start creating these kinds of plantings, Rainer and West (2015) have defined a way of working with layers when designing plant communities. They base their ideas on Grime's CSR-theory and some other categorisations of plants. They divide the planting into four plant layers, which are further divided into two design layers and two functional layers. The structural/framework plants and the seasonal theme layer plants belong to the design layer and the ground cover plants and filler plants belong to the functional layer (see figure 6). According to Rainer and West (2015):

The structural/framework plants should comprise 10-15 % of the planting. These plants are the tall plants that form the structure of the planting and are often competitors or stress-tolerators. They are long-lived and have clear shapes.

25-40 % of the planting should consist of seasonal theme plants. As the name reveals, they are a seasonal theme of the planting, giving a splash of colour during a part of the growing season. C-, S- and R-strategists are all possible seasonal theme plants.

Ground cover plants should make up for 50 % or the planting. These plants are low and often rhizomatous, weaving between the other plants covering the ground. They also function as erosion control and nectar source for pollinators.

Filler plants make up for 5-10 % of the planting. They are ruderals and other short-lived plants that are meant to fill the gaps of a planting and give brief seasonal interest. They are fast-growing but cannot stand too much competition.

The German mixed planting system uses the same kind of categorising (Bds, 2019), with slightly different names, emerging plants are essentially the same as structural/framework plants and companion plants are the equivalent of seasonal theme plants. With some small differences in ratios, the ideas are very similar to one another.

Dunnett, Kircher and Kingsbury (2004) give a checklist of things to consider when choosing plants for a perennial mix. Habitat requirement, life cycle, ecological strategy, regeneration, aesthetic characteristics, structural characteristics, phenology and maintenance intensity are factors that must be well-thought out to develop a successful mix. Based on trials, professor Wolfram Kircher has come up with proportions of structural types that should give a good result for a mixed planting: on an area of 100 m², 1-5 emerging perennials, 10-50 companion perennials, 30-80 ground-covering perennials and 30-300 scattered perennials (Dunnett et al., 2004).

According to Rainer and West (2015) the key to a successful designed plant community is to understand that it is in fact a community, which means that plants work together. They state that "The good news is that is entirely possible to design plantings that look and function more like they do in the wild: more robust, more diverse, and more visually harmonious, with less maintenance. The solution lies in understanding plantings as communities of compatible species that cover the ground in interlocking layers" (Rainer & West, 2015, p.17). They admit that this is not a simple

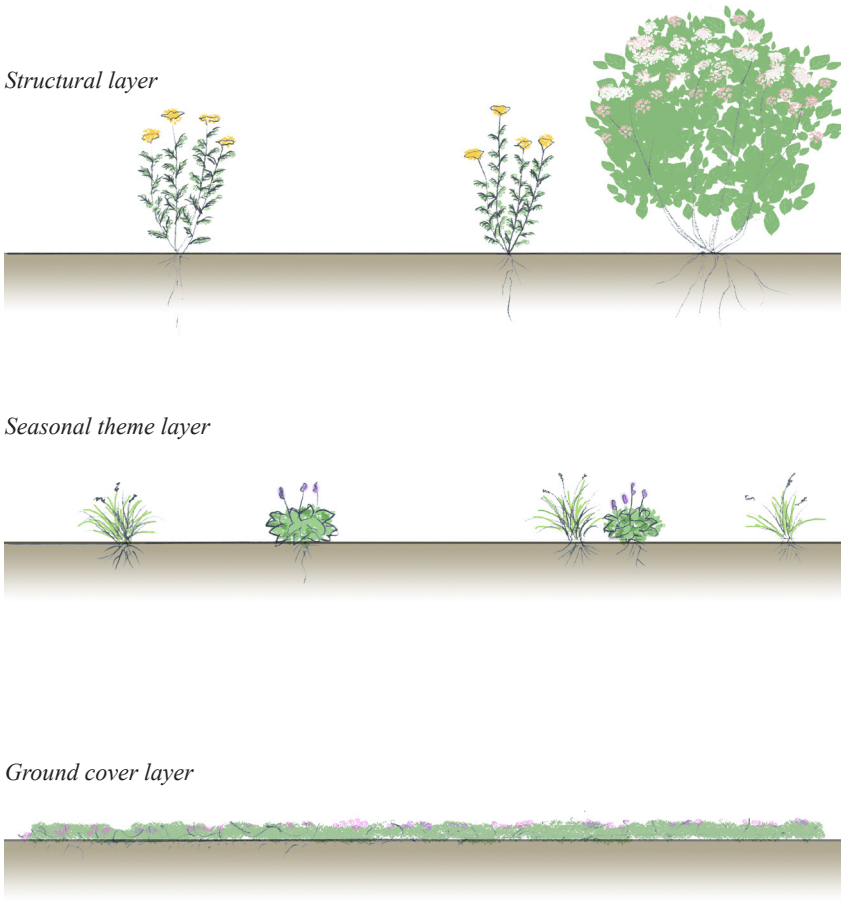


Figure 6. The different layers of a designed plant community, based on Rainer & West, 2015. The filler layer is not visualised, it is a layer that comes and goes, when gaps need to be filled.

task: “we need to design differently. We need a new set of tools and techniques rooted in the way plants naturally interact with a site and each other. This requires a deeper understanding of plants and their dynamics” (Rainer & West, 2015, p.62)

The shape of the plant and their way of growing are important factors when making plant choices for any planting. Oudolf and Kingsbury (2013) mention that plant architecture is the term that has become common to use for describing the shape of the plant.

The layers below ground are equally as important as the ones above ground. Different root structures make it possible for plants to co-exist, taking up nutrients and water from different depths in the soil, see figure 7 (Rainer & West, 2015). Every plant has their ecological niche and the way plants grow together is mainly because they use different aspects of the growing environment (Dunnett, 2004), such as having their roots in different depths of the soil.

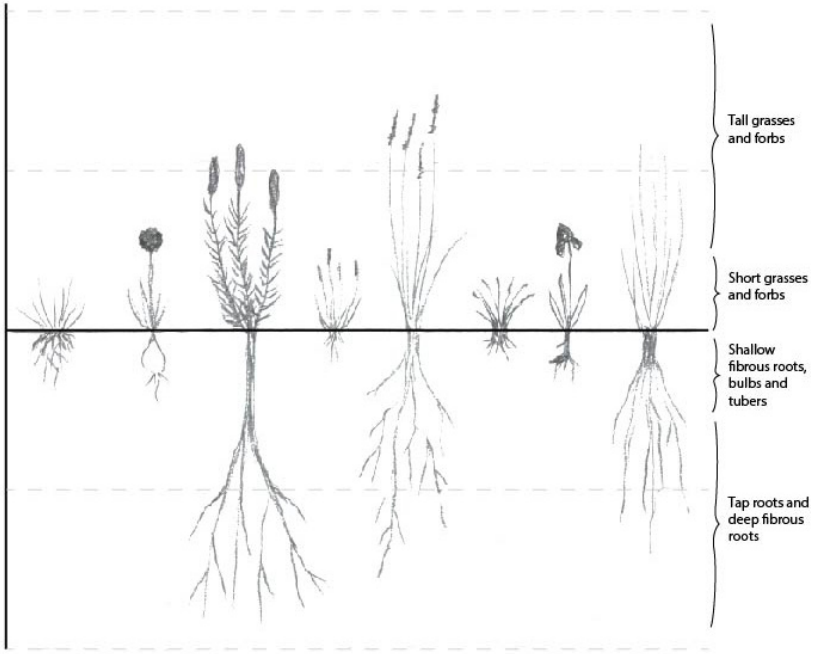


Figure 7. Roots at different depth of the soil, allowing species to grow next to one another. Adapted from Rainer & West, 2015.

Aesthetics/Public perception

All the authors that contributed to the book The Dynamic Landscape (2004) have the uniting idea that designed nature-like plantings in an urban environment have to be aesthetically pleasant to be able to get public acceptance and liking. Dunnet and Hitchmough (2004) state that nature-like plantings that do not seem clearly designed and cared for are not particularly valued by the public. Professor Joan Iverson Nassauer (1995) suggests a solution to gain public acceptance for naturalistic plantings; orderly frames: A clipped hedge, a path or a wall for example gives the planting frames, which makes it seem less disorderly.

There seems to be a debate about the appropriate use of mixed/ecological plantings in urban space in terms of scale. Landscape architect Petra Pelz (2004) argues that plantings in an urban setting should be large in scale to be able to compete with the other large structures in an urban environment. In his article Uwe Jörg Messer (2004) states that random mixes are especially good for smaller areas, such as roundabouts and thinks that they work badly for big areas. Hitchmough (2004) states that the most dramatic effect is achieved when a naturalistic herbaceous planting, such as a designed meadow, is more than 100 m². As Hitchmough (2004) points out, naturalistic herbaceous vegetation can tie together the other elements of the environment, forming a more harmonious whole.

According to Dunnett (2004) one of the greatest advantages with ecological plantings is the fact that you can get a visually attractive design with almost no site modification. With the right plant choices, there is no need to change the soil dramatically (Kingsbury, 2014). If soil is added, witch often is the case in

urban environments, the soil should be free from weeds. Most often, the biggest challenge during the establishment of a planting is weed competition (Kingsbury, 2014).

Even though plants in natural plant communities seem to be distributed randomly, they are in fact in most cases not (Dunnett, 2004; Oudolf & Kingsbury, 2013). Small differences in for example soil moisture or pH can result in a specific distribution of a species. Dunnett (2004) states that species are actually placed in patterns and therefore patterns can be used a tool when designing diverse naturalistic plantings.

One reason why naturalistic herbaceous planting has not become more common yet is the fact that it does not fit the traditional client-landscape architect-contractor model as well as traditional planting does according to Hitchmough (2004).

Plants that originate from the same natural habitat often look alike, for example broad leaves on shade-tolerant species, which means that they often go very well together (Kingsbury, 2014). It is understandable that plants usually thrive in conditions that are close to their natural habitat. However, the further north you go, the weaker the sunlight becomes, and you can use some shade-tolerant species in conditions with more light, even full sun (Kingsbury, 2014).

Lebensbereich, German garden habitat or the Hansen school

The Lebensbereich style is an ecological planting style that came from Germany, also called the Garden habitat or the Hansen school. The style has been used in public plantings, such as garden shows, mostly in Southern Germany (Kingsbury, 2004). Lebensbereich originates from the work of professor Richard Hansen at the University of Weihenstephan in Freising, Bavaria (Oudolf & Kingsbury, 2013). Many decades of research are behind the style. The word lebensbereich means “living space”, and the idea behind the style is the connection between the ecological conditions of the site and how they match the ecological preferences of a plant species (Kingsbury, 2004).

Hansen and Stahl (1993) present seven different garden habitats, most of them based on natural habitats. The habitats are woodland, woodland edge, open ground, rock garden, border, water’s edge and march and water, the border habitat being clearly non-natural. The levels of sociability discussed earlier in this work, formed a base for this style (Dunnett *et al*., 2004), but planting schemes based on the levels of sociability can be time-consuming to produce. In their book, Hansen and Stahl (1993) state that satisfactory results cannot be achieved by randomly mixed plantings. The style never became really popular and Kingsbury (2004) suggests that the reason for that is, that Hansen’s work may be too large and detailed. Dunnett et al. (2004) state that the method is best used in private gardens, due to the need of a very detailed planting plan.

The Mixed planting system

In Germany there has been a public investment to develop a Mixed Planting system (Staudenmischpflanzung), perennial mixes suited for different habitats. The system is almost like a simplified version of the Lebensbereich style. Simplified in the sence that there are readily made plant compositions to choose from for different kinds of habitats. There is also a similar system developed in Switzerland, the Integrated Planting system (Oudolf & Kingsbury, 2013). The Mixed Planting system has been a cooperation between

universities and other educational and research institutions. The development started at Anhalt University of Applied Sciences (Hochschule Anhalt) in Bernburg, Germany (Kircher et al., 2012) and most of the mixes so far have been developed there (Oudolf & Kingsbury, 2013). The German Perennial Nursery Association (Bund deutscher Staudengärtner) has supported the creation of the mixes and therefore clients can buy the mixes at members of the association (Oudolf & Kingsbury, 2013).

One reason to why this type of planting system was developed in Germany and Switzerland is that a lower cost solution for larger plantings for public sites was needed (Oudolf & Kingsbury, 2013). The savings come from developing mixes that can be used again and again in similar conditions, from the maintenance work being limited and from the lower cost of planting, since no drawn planting plan must be followed.

Being a public investment has made it possible to test the mixes thoroughly. The most well-known mix, Silbersommer for example, was tested in 13 different places in Germany and Austria (Oudolf & Kingsbury, 2013). There have also been trials testing the optimal spacing of plants in the mixes. As a general rule, a wider spacing such as 4-6 plants/m² has been found to be preferable over a denser spacing of 8-12 plants/m² (Oudolf & Kingsbury, 2013).

German professors Walter Kolb and Wolfram Kircher were the ones that first came up with the idea of the mixed plantings in the 1990s and invented the term *Staudenmischpflanzung*, Mixed planting (Kircher et al., 2012). Their aim was to develop a simpler version of the levels of sociability presented in Hansen and Stahl (1993). The concept is based on completely random mixes, so no planting plan with specific placing is drawn. This means that the cost of design is reduced significantly, and the plantings appear quite natural since no pattern is intentionally designed.

The mixed plantings have been designed for extensive management, meaning that they are managed as a unit and not plant by plant. The mixes should function almost like a false ecosystem (Oudolf & Kingsbury, 2013). Each plant is chosen based on their habitat, competitive behaviour, flowering, size and propagative behaviour (Kircher et al., 2012).

A wide variety of species supports the longevity of wild plant ecosystems, but there is no evidence that the case would be the same for designed plantings. There is a high amount of species in the German mixes, for example Silbersommer has 30, and the supporters of this planting system seem to think that is the key to their long-term survival. (Oudolf & Kingsbury, 2013)

Kircher et al. (2012) recommend the mixes to be used in e.g. traffic islands and roundabouts and in small beds along or between hard surfaces.

There are five different layers or categories of a planting according to the mixed planting system. They are the emerging plants, companion plants, groundcovers, filler plants and geophytes. There are a lot of ways to categorise plants, but most relevant for mixed plantings is plant structure. According to Oudolf and Kingsbury (2013), there must be a balance of the structure in the mixes. The mixed plantings usually have a ratio of 5-15 % emerging plants, 30-40% companion plants and 50% groundcover plants (BdS, 2019). Filler plants and geophytes can also be a part of the mix. Instead of traditional drawn planting plans, the planting of the mixes can be explained in words instead (Messer, 2004).

Emerging plants are as their name suggests plants that emerge from the planting. They are often visually very attractive, they flower beautifully and create strong structural silhouettes in the planting.

Companion plants are often clump-forming plants that form the green mass of the planting. They are long-lived.

Groundcovers are probably the most important part of the planting functionally. Their task is to cover the ground to stop "weeds" from establishing and to keep the moisture from evaporating too quickly from the soil.

Filler plants are often short-lived fast-growing plants that are used to fill in the gaps in the mixes especially in the early stages of the planting (Oudolf & Kingsbury, 2013) when the slower growing plants have not reached their full size yet. They are not always perennials, they can also be annuals or biennials that seed efficiently. The filler plants can also work later in the established planting when for some reason another plant fails to grow and leaves a gap.

Bulbs, corms and tubers are together called geophytes. Geophytes are often added to a planting to add spring colour and prolong the flowering period. Geophytes are excellent additions to a planting since they give a big impact but only take a small amount of space. They are especially suitable in these kinds of mixed plantings since their decomposing leaves are hidden by the other plants after they have flowered.

Together these groups of plants form different layers of the planting. A particular species does not belong to one group specifically, it is a matter of balance between the other species that make a functioning mix together.

Disadvantages

Messer (2004) brings up a disadvantage with the random mixes; there is a risk of the perennials being unevenly spread out and the planting may end up looking disorderly. He also states that to develop such mixes, good plant knowledge is very important.

Messer (2004) thinks that random perennial mixes are unsuitable for formal or architectural design, but Dunnett and Hitchmough (2004) think that it is a matter of changing people's perception of naturalistic plantings. Kingsbury (2004) suggests a way of "stylising" nature, meaning that in order to please the public you should choose plants/plant communities that have high visual interest.

As pointed out by Oudolf & Kingsbury (2013) the mixed planting system has a big disadvantage; the mixes can be repeated so many times that they become overused and therefore a cliché. A solution could be to always change some of the species to better fit the specific site being designed and at the same time get a more unique result. However, Kircher et al (2012) state that even though the same mix is used, the plantings will form their own dynamics depending on the conditions in each area where they are planted and will therefore each have their individual appearance.

Another problem with planted random mixes is the fact that, in contrast to natural plant communities where the community develops over time, in a planted situation all species start growing at the same time (Oudolf & Kingsbury, 2013). A sown mix has a better chance at developing more naturally, since the species will find their niches to grow in, based on the small differences

in growing conditions, such as moisture and fertility (Dunnett, Kircher and Kingsbury, 2004). Additionally, seeds produce genetically diverse plants whereas plants from nurseries are mostly clones, which means they come from a very limited genepool and are at greater risk when it comes to e.g. diseases.

According to Dunnett et al. (2004) mixture-based planting has been seen as diminishing the value of the planting designer and has therefore been criticised by landscape designers and horticulturalists.

The mixes developed so far

The German Perennial Nursery Association has got information about all the mixes developed so far on their webpage (Bds, 2019). There are seven main categories based on the conditions that the mixes are suitable for, ranging from dry open places to shaded areas (Bds, 2019). The categories are (the most relevant for this work are bolded):

- **Mixes for dry to moderately dry open spaces**
- Mixes for fresh to moderately dry open spaces
- Mixes for fresh to moist open spaces
- Mixes for sunny to half-sunny woodland edge (fresh to moderately dry soil)
- Mixes for the partially shaded to half-sunny, cool woodland edge (fresh to moderately dry soils)
- Mixes for partially shaded to shaded areas under trees (fresh to moderately dry soils)
- **Mixtures for tree disks and dry shady woody areas**

Each of these categories then contain a varied amount of mixes for these conditions. The mixes are named based on their visual character and expression. In table 3 all the mixes developed so far are listed according to their habitat. From these the four mixes that are highlighted are the ones that will be developed further in the fifth chapter.

Different applications of the mixes

Kircher et al. (2012) have listed six different ways of applying the mixes. The first one is the completely random planting, with only quantities of plants per for example square metre. The second option is to in addition to quantities, specify that some species are to be planted in small groups or in a specific place. The third option is to add an illustration where the tallest species are shown on the planting plan, while the shorter species remain a random mix. The fourth option is to make an illustration showing which plants should be planted in groups as a core group of the planting. The fifth option is a good option for larger areas. In this option the planting area is divided into smaller parts, so that the planting does not look too uniform. The smaller parts can have different mixes or the same mix but with variations of quantities. The final option that Kircher et al. present is to plant the mix into an existing vegetation or with seed mixes to get a more spontaneous look.

Table 3. A list of the mixes developed so far showing the habitats they are meant for. (Bds, 2019b)

Mix, German name (English name)	Habitat	Institution
Mixes for dry to moderately dry open spaces		
Blütenmosaik (Flower mosaic)	dry to moderately dry	LWG Veitshöchheim
Blütenschleier (Flower veil)	dry, well-drained without waterlogging	University of Applied Sciences Anhalt, Bernburg
Heimische Blütensteppe (Domestic flower steppe)	dry, deep calcareous gravel-rich substrate	University of Applied Sciences Anhalt, Bernburg
Blütentraum (Blossom dream)	dry to moderately dry	LWG Veitshöchheim
Blütenwogen (Flower whorls)	dry open spaces	University of Applied Sciences Anhalt, Bernburg
Blütenzauber (Flower magic)	dry, well-drained soil	LWG Veitshöchheim
Farbenspeil (Play of colours)	dry, well-drained soil	LWG Veitshöchheim
Indianersommer (Indian summer)	dry, well-drained, soils with gravel or grit	Schau- und Sichtungsgarten Hermannshof
Präriemorgen (Prairie morning)	dry, well-drained, soils with gravel or grit	Schau- und Sichtungsgarten Hermannshof
Silbersommer (Silver summer)	dry, well-drained, problematic locations	Bds
Sommerwind (Summer wind)	dry to moderately dry without waterlogging	Hochschule Wädenswil
Tanz der Gräser (Dance of grasses)	dry, well-drained, moderately nutritious	LVG Erfurt
Mixes for fresh to moderately dry open spaces		
Blütenflamme (Flower flame)	fresh to moderately dry	University of Applied Sciences Anhalt, Bernburg
Blütenwinter sonnig (Winter blossom, sunny)	fresh to moderately dry	University of Applied Sciences Anhalt, Bernburg
Blütenwucht (Floral force)	drought tolerant	University of Applied Sciences Anhalt, Bernburg
Fleur und Flamme (Fire and flame)	moderately dry to fresh	LVG Erfurt
Indian sunset (Indian sunset)	dry	Hochschule Wädenswil
Präriesommer (Prairie summer)	moderately dry to fresh, well-drained	Schau- und Sichtungsgarten Hermannshof
Sommernachtstraum (Midsummer Night's Dream)	fresh	Hochschule Wädenswil
Mixes for fresh to moist open spaces		
Pink Paradies (Pink paradise)	humid	Hochschule Wädenswil
Mixes for sunny to half-sunny woodland edge (fresh to moderately dry soil)		
Blütenchill (Flower chill)	dry to fresh	University of Applied Sciences Anhalt, Bernburg
Bernburger Blütensaum (Bernburg flower border)	dry to slightly dry	University of Applied Sciences Anhalt, Bernburg
Thüringer Blütensaum (Thuringian flower border)	fresh to moderately dry	LVG Erfurt
Veitshöchheimer Blütensaum (Veitshöchheim flower border)	fresh to moderately dry	LWG Veitshöchheim
Blütenserenade (Flower serenade)	not too dry	University of Applied Sciences Anhalt, Bernburg
Blütenwinter halbschattig (Winter blossom, half-shady)	fresh to moderately dry	University of Applied Sciences Anhalt, Bernburg
Blütenwucht (Floral force)	drought tolerant	University of Applied Sciences Anhalt, Bernburg
Farbensaum (Colour flower border)	fresh to moderately dry	LWG Veitshöchheim
Mixes for the partially shaded to half-sunny, cool woodland edge (fresh to moderately dry soils)		
Shattengeflüster (Shadow wispers)	fresh to moderately dry	Schau- und Sichtungsgarten Hermannshof
Shattenzauber (Shadow magic)	fresh, nutricious	Schau- und Sichtungsgarten Hermannshof
Shattenglanz (Shadow xx)	fresh to moderately dry, nutrient-rich	Schau- und Sichtungsgarten Hermannshof
Blütenwandel (Blossom change)	dry or alternating dry	University of Applied Sciences Anhalt, Bernburg
Mixes for partially shaded to shaded areas under trees (fresh to moderately dry soils)		
Blütenshatten (Blossom shadow)	dry, lime-tolerant	University of Applied Sciences Anhalt, Bernburg
Mixtures for tree disks and dry shady woody areas		
Winterharmonie (Winter harmony)	moderately dry	Schau- und Sichtungsgarten Hermannshof
Licht & leicht (Light & light)	dry to moderately dry	Schau- und Sichtungsgarten Hermannshof
Winterglanz (Winter shine)	dry to moderately dry	Schau- und Sichtungsgarten Hermannshof
Natiurlich & robust (Natural & robust)	moderately dry	Schau- und Sichtungsgarten Hermannshof
Wintersilber (Winter silver)	fresh to moderately dry soil	Schau- und Sichtungsgarten Hermannshof
Wintergold (Winter gold)	fresh to moderately dry soil	Schau- und Sichtungsgarten Hermannshof
Spotlights (Spotlights)	fresh to moderately dry soil	Schau- und Sichtungsgarten Hermannshof
Filigran (Filigree)	dry to moderately dry	Schau- und Sichtungsgarten Hermannshof

Development of dynamic plantings and guidelines for them in Finland

What has been done in Finland when it comes to designed plant communities? It seems like the capital, Helsinki, has come the longest way in acknowledging designed plant communities and trying to develop design and management guidelines for such plantings. For the past 10 years the city of Helsinki has had as a goal to increase the diversity of public plantings and avoid mass plantings (Tegel, 2009), but it is not until recently that the term dynamic planting (dynaaminen istutus in Finnish) has become the most commonly used term when discussing ecologically informed plantings in urban areas. In 2012 in a pilot project (also a student bachelor work), two dynamic perennial plantings were designed and planted in Helsinki (Mäkinen, 2013). The development of the plantings has been followed since and in 2017 the plantings were inventoried to see if the plantings had been successful. Both plantings, a woodland and prairie type, had been successful and had overcome some weed problems that existed in the beginning (Karilas, 2018). In the end of 2018 the Urban Environment Division at the city of Helsinki published guidelines for dynamic plantings on their webpages (Kaupunkiympäristön toimiala, Helsinki, 2018). A handbook on dynamic herbaceous vegetation was also published in the spring 2019 by the The Finnish Association of Landscape Industries – Viherympäristöliitto ry. The handbook is a guide for implementing dynamic plantings, focusing on the planning of such plantings (Karilas, 2019).

Perennial trials in Finland

In a study conducted from 2005 to 2010 several herbaceous perennials were tested in Finland to see if they would be suitable to grow in northern conditions. The aim of the study was to find hardy perennials and combinations of them, that could be used for low-maintenance plantings in parks, cemeteries and traffic islands. (Juhanoja & Tuhkanen, 2010)

Tuhkanen and Juhanoja (2010) state that an ideal perennial for a low-maintenance area is quickly ground-covering, which indicates that they mainly consider mass plantings of a single species (or blocks of species), rather than a mix of species with different qualities and long-term visual interest. Juhanoja and Tuhkanen (2010) say that research results, plant species and maintenance techniques from other countries cannot be directly implemented in Finland because of the difference in climate conditions. They also bring up the challenges we face with climate change, how winters with more unpredictable weather, e.g. hard frost during snowless periods, require a lot from the plants.

Finnish nurseries and private collections have a lot of ornamental perennials that are adapted to the climate in Finland, but according to Juhanoja and Tuhkanen (2010), many of them are not grown commercially and risk to be replaced by products imported from foreign nurseries. The warming climate due to climate change has meant that the growing season has become longer in Finland. This has led to new species being able to be grown further north than before. A longer growing season increases the risk for spring frost however, and Tuhkanen and Juhanoja (2010) found in their study that spring frost damaged some species that they tested, such as *Astilbe ssp*. and *Dicentra ssp*., in Piikkiö, southern Finland.

Growing conditions

4

There are a lot of factors that affect the growing conditions for a plant. Light conditions and access to water and nutrients are the most important ones, soil acidity, wind conditions and temperature are others. The smaller the plant the smaller its habitat/niche can be and even the tiniest changes in microclimate and soil conditions can affect how well the plant thrives. In this part of the text the growing conditions for urban areas in southern Finland are presented, by looking into the overall climate in Finland as well as the difference between urban and rural climate. In the end some challenging urban habitats are defined.

Growing conditions in southern Finland

Finland is located in Northern Europe bordering Sweden to the west, Norway to the north and Russia to the east. The country is long and growing conditions vary a lot from north to south. According to the Köppen climate classification most of Finland belongs to the Subarctic climate type, with the exception of the south western archipelago and the north western tip of Finland (Kersalo & Pirinen, 2009). The Subarctic type is characterised by the warmest month having a mean temperature of at least +10ºC and the coldest one at least -3 ºC (Kersalo & Pirinen, 2009). Finland is divided into 5 climate zones, also called nature zones, from the south to the north they are: the hemiboreal, the southern boreal, the middle boreal, the northern boreal and the hemiarctic zone, shown in figure 8.

Finland is also divided into 9 different vegetation hardiness zones (Kersalo & Pirinen, 2009), see figure 9. Woody plants are categorised in different hardiness zones, based on the length of the growing season, cumulative temperature and winter conditions

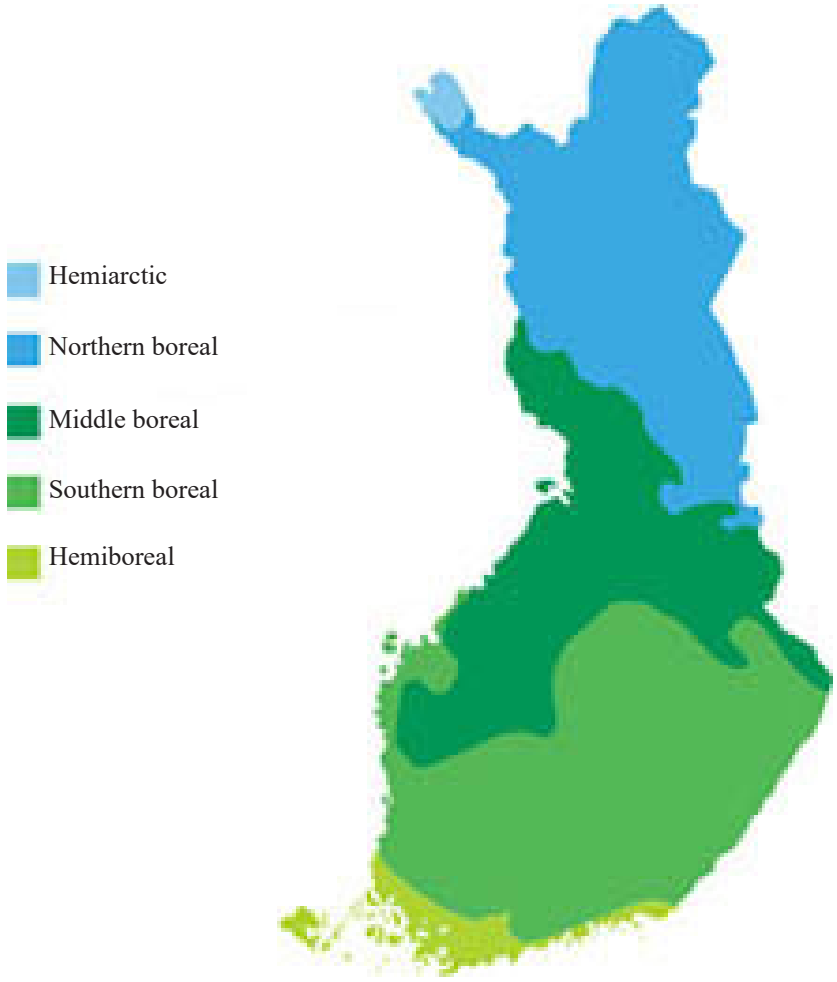


Figure 8. The 5 climate zones of Finland. Adapted from Kersalo & Pirinen, 2009.

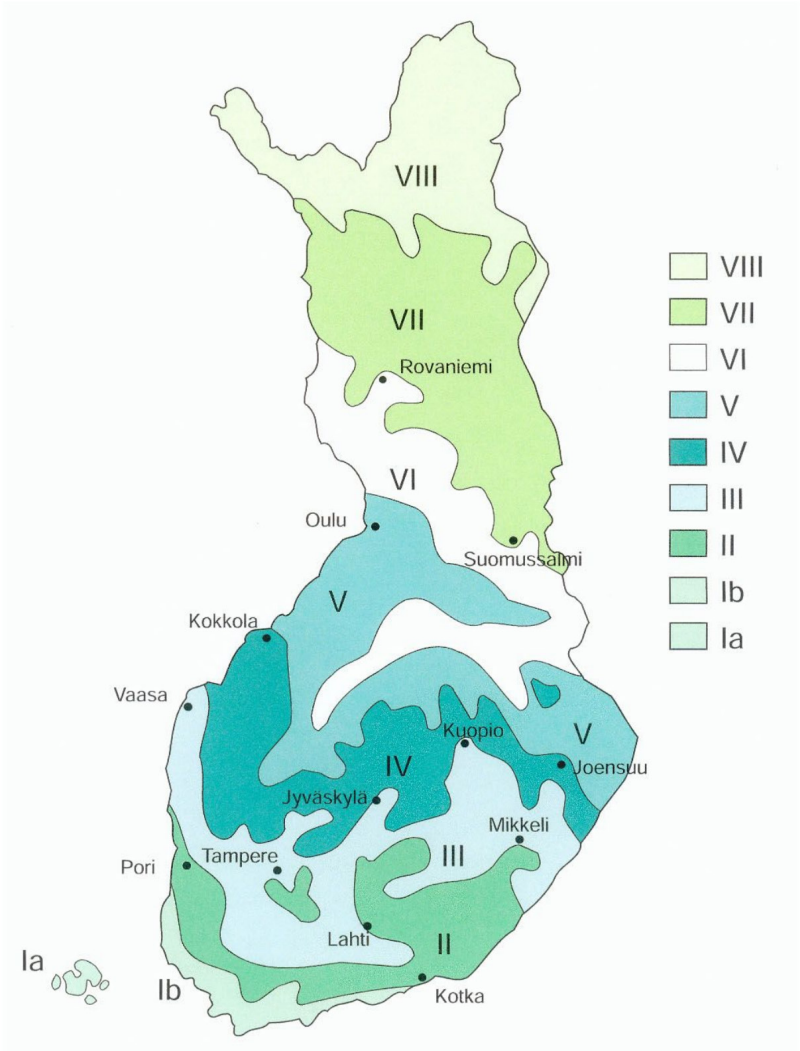


Figure 9. Map showing hardiness zones for woody plants in Finland (Ilmatieteen laitos, 2011)

(Ilmatieteen laitos, 2011). The hardiness zones for woody plants can serve as a base when trying to figure out if a perennial would work in a specific climate or not. The climate zones and hardiness zones follow roughly the same borders, zone 1a and 1b are in the hemiboreal zone, 2-4 are in the southern boreal zone, 5 and 6 are in the middle boreal and 7 and 8 are in the northern boreal. The hardiness zones are not set in stone, microclimate plays a role in this as well and as previously stated, the urban climate differs from the rural one, therefore affecting the growing conditions. If perennials fail to grow somewhere, the reason is usually that it has been planted in the wrong conditions (Alanko, 2007), meaning the microclimate and the specific conditions on site instead of the overall climate.

The thermal growing season

The thermal growing season starts when the mean daily temperature is above +5ºC and the snow has melted from open places and ends when the daily mean temperature drops below 5 degrees again (Kersalo & Pirinen, 2009). In the southern parts of the country the growing season starts in the end of April and ends by the end of October (Ilmatieteen laitos, 2019), see figure 10. The cumulative temperature is calculated by summing up the mean daily temperatures above 5 degrees. The mean annual cumulative temperature varies between over 1300ºC in the southwest to below 500ºC in the north (Kersalo & Pirinen, 2009). The variations between years are big however and growing conditions depend on other weather events such as rain as well.

Temperature

The mean annual temperature in Finland varies from above +5ºC to below -2ºC and sinks consistently from the southwest to north,

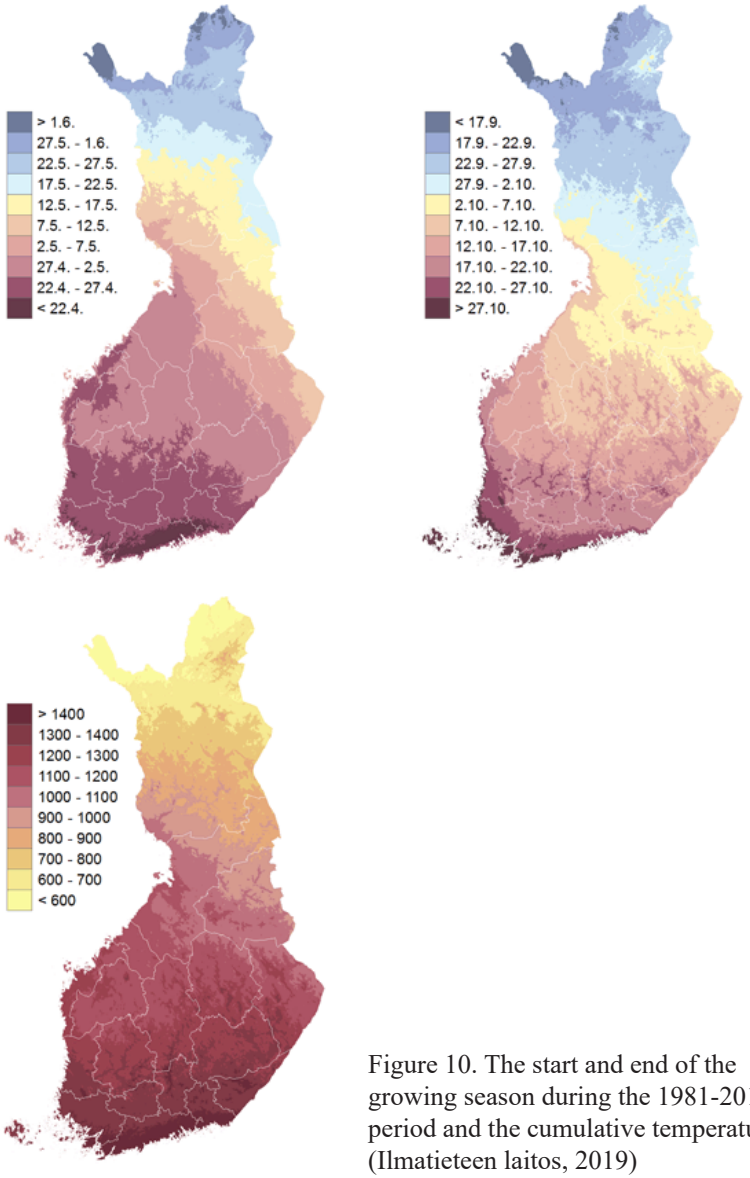


Figure 10. The start and end of the growing season during the 1981-2010 period and the cumulative temperature. (Ilmatieteen laitos, 2019)

see figure 11 (Ilmatieteen laitos, 2018). The warmest month is usually July and the coldest one is usually January (Kersalo & Pirinen, 2009).

Precipitation

The mean annual precipitation in Finland during the period 1981-2010 was 400-750 mm (Ilmatieteen laitos, 2018). The rainiest areas are in the south and the driest in the north, see figure 12. The annual precipitation varies much less in Finland than in areas in similar latitudes, the precipitation is divided fairly equally throughout the whole year (Kersalo & Pirinen, 2009). There are small differences however, and the rainiest period is in July-August and the driest periods are in mid-winter and spring (Kersalo & Pirinen, 2009). There are also big differences from year to year (Kersalo & Pirinen, 2009).

A part of the annual precipitation is snowfall instead of rainfall, about a third in the south-western parts of the country and 40-50 % in the rest of the country, apart from some high-altitude regions in Lapland, where it is approximately 60 % (Kersalo & Pirinen, 2009).

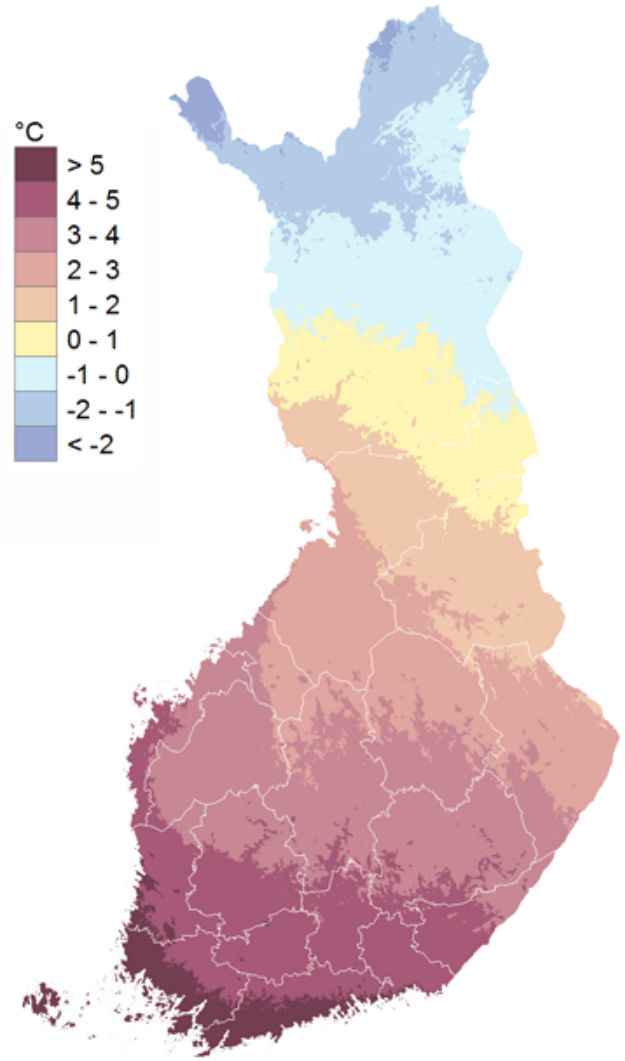


Figure 11. The mean annual temperature in Finland during the period 1981-2010. (Ilmatieteen laitos, 2018)

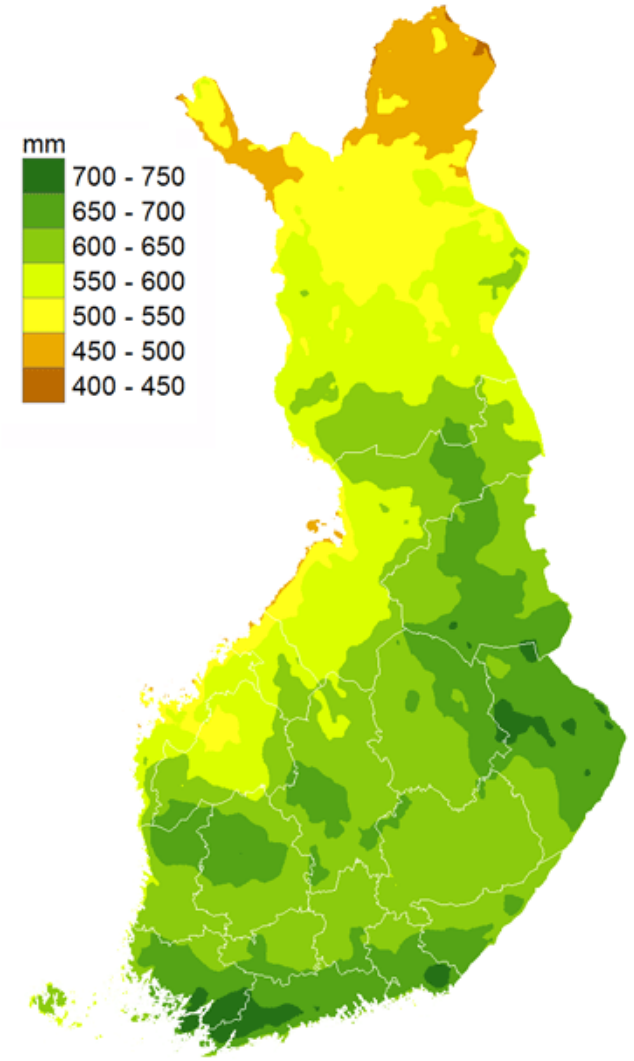


Figure 12. The mean annual precipitation in Finland during the period 1981-2010. (Ilmatieteen laitos, 2018)

The urban climate

The urban climate differs in many ways from the rural climate. Human activity is the cause for this and our actions affect almost all meteorological variables, like wind, air pollution and temperature (Parlow, 2011). Man-made structures such as buildings and other hard surfaces affect the aerodynamics, leading to changes in wind behaviour, the hard materials in cities have a higher heat radiation than rural surroundings and there is also a high level of emissions from e.g. traffic and industries (Parlow, 2011).

The climate in cities is different to the climate outside the same cities. One of the most relevant is the temperature, which is higher in urban environments than in the surrounding countryside (Niemelä, 1999). The heat is stored in buildings during the day and is released during the night (Gilbert, 1989), causing higher temperatures. This phenomenon is called the urban heat island effect and the daily or annual mean temperatures are normally a few degrees higher in urban areas (Parlow, 2011). The urban heat island effect is not limited to a single season, the phenomenon occurs all year around (Parlow, 2011). Parlow (2011) also states that the bigger the urban area, the bigger the difference in temperature is.

The microclimate of cities can mean that plants that should not be hardy in certain latitudes, still manage to grow there. Gilbert (1989) mentions an example from Chelsea Physic Garden in Central London, where a 10-meter-tall olive tree is not only growing but also produces olives.

According to Gilbert (1989), there is a 5-10 % higher amount of precipitation in urban areas compared to rural, but the increase concerns mostly heavy rain and thunderstorms, which means it does not affect the vegetation significantly. In urban areas, where hard surfaces dominate, heavy rains mostly go into the sewage system. Gilbert mentions a German study, that found that even though there is a slightly higher amount of precipitation in urban areas, the urban environment is in fact dryer than the surrounding rural areas. The fast runoff caused by impermeable surfaces cancel out the higher amount of rainfall.

Climate change

According to the Intergovernmental Panel on Climate Change (IPCC, 2018), global warming will reach a temperature rise of 1,5ºC between the years 2030 and 2052. Even higher temperature changes can be noticed in land regions and during some seasons, and for example the Arctic suffers from a two- or three-times higher warming than the global average (IPCC, 2018). There has already been an increase in extreme weather events, when it comes to their intensity and frequency, so an even bigger increase in global temperatures are believed to increase these events further (IPCC, 2018).

In Finland, the winters will become warmer and therefore wetter due to climate change, because of an overall increase in precipitation, but also since a lot more of the precipitation will be rainfall instead of snowfall (Ruosteenoja, Jylhä & Kämäräinen, 2016). The temperatures in summer are not expected to rise as much as in the wintertime (Ruosteenoja et al, 2016).

Oudolf and Kingsbury (2013) suggest that natural plant communities in stressed environments could be used as a reference for plantings in a world where climate change will increase extreme weather. Steppes of eastern Europe and central Asia have hot summers and cold winters, a type of climate that

could become more common because of climate change.

Challenging urban habitats

As stated previously, urban conditions are warmer and more extreme than in rural areas. In urban areas soil depth is often shallow and the soil is often man-made, which means it lacks some qualities that natural soils have. According to Gilbert (1989) the structure development of urban soil often gets disrupted by compaction from for example heavy machinery. This leads to soil with little air pockets and poorer water permeability. In addition to challenging weather conditions, some spots in urban areas can be tricky or dangerous to access when vegetation management is needed, such as traffic medians or roundabouts. Another common and challenging habitat is found under mature urban trees, where water resources are limited, and the canopy of the tree is shading the ground.

"As extreme and unnatural as urban conditions may seem, there is likely a native plant community in the wild that thrives under similar conditions" (Rainer & West, 2015, p. 131). As this quote tells us, only the most extreme of conditions are uninhabited by plants and therefore we should just look at the examples we find in nature to find solutions for even the seemingly most unnatural places.

5 The perennial mixes

Introduction to the mixes

Mix 1: Kuohu

Mix 2: Kaino

Mix 3: Onni

Mix 4: Kaiho

Introduction to the mixes

In this part of the work designed plant communities for some challenging urban conditions will be presented. The mixes are not tested but are based on the German mixed planting system, modified based on knowledge gained during the course of this work from the literature.

The main source of information about the hardiness of the species is a book about perennials suitable for cultivation in Finland, *Perennat* (Perennials) by Pentti Alanko from 2007. Another source used is *Pohjolan perennat – monivuotisten kukkien ominaisuudet ja käyttö* (Perennials of the north – qualities and use of perennial flowers) by Jari Särkkä and Esa H. Ukonaho from 1998. *Viljelykasvien nimistö* (Nomenclature of cultivated plants) a publication by Puutarhaliitto, the Central Organisation for Finnish Horticulture with names of species that are in cultivation in Finland or imported to Finland, is also used. The website Laji.fi, by the Finnish Biodiversity Information Facility, was also used to determine if a species grows in Finland. The plant descriptions (height, flowering time and colour) are taken from the literature and from Finnish nurseries, since size and flowering time depends on the climate.

The mixes from the German mixed planting system that will be developed further are; Silbersommer (Silver summer in English), Filigran (Filigree), Prärieмorgen (Prairie morning) and Blütenmosaik (Flower mosaic). The mixes have been given new names, so that the name matches the new appearance.

All the mixes are meant to be low-maintenace, annual cutting back in early spring being the only maintenace mearsurement. This is achieved by following the principles described in this work earlier, by creating layers in the planting, cowering the ground completely. The species chosen do not require dividing or individual care, the planting is treated as a whole.

The mixes have been given new names, to support the idea that these would be brands that could be sold by their name in any nursery. The names are Finnish words, because that is where the mixes would be sold.

Mix 1: Kuohu

based on Silbersommer (Silver summer, See appendix A for the original plant list)

The name Kuohu (literal translation foam) comes from the feeling of this mix welling of different species, with many having white flowers.

Habitat: full sun, well-drained, calcareous

Examples of this kind of habitat: roundabouts, roadsides, traffic medians, next to buildings or walls on the south-facing side

Visual description: Silvery and white tones with splashes of colour

Management: Annual cutting back in early spring , some weeding might be needed in the first years after planting

Silbersommer (Silver summer) is the most well-known of the mixes developed in the mixed planting principle and it was also the first mix to be completed in 2001 (Oudolf & Kingsbury, 2013). It was developed by a research group at the German Perennial Nursery Association (Oudolf & Kingsbury, 2013). The habitat the mix is designed for is full sun, well-drained and calcareous soil. This mix has 30 species; seven emerging plants, seven companion plants, four filler plants, seven groundcovers and five geophytes.

The reason why Silbersommer was chosen as one of the mixes for this work is that it is the most common of the German mixes, suggesting that it is appreciated and works well for the described habitat.

Plant list

Scientific name	Amount/100m²	Height	Flower colour	Flowering time
1.Emerging plants				
Achillea filipendulina 'Coronation Gold'*	20	80cm	yellow	7-8
Sesleria heufleriana	10	20/30cm	-	5-6
Perovskia 'Little Spire'	10	45-60cm	blue	8-9
Phlomis tuberosa	10	120-180cm	purple	7-8
Sedum 'Herbstfreude' *	25	40cm	pink	8-10
Achnatherum calamagrostis *	10	70cm	-	6-11
Verbascum bombyciferum *	10	160cm	yellow	7-8
2. Companion plants				
Anaphalis triplinervis	35	30cm	white	7-8
Aster sedifolius	35	60-80	blue	8-10
Aster linosyris *	35	40cm	yellow	7-9
Euphorbia polychroma *	35	30-60cm	yellow	5-6
Campanula persicifolia 'Alba'	20	60cm	white	6-8
Knautia macedonica *	35	50-80cm	wine red	7-8
Veronica austriaca ssp. teucrium 'Knallblau' *	35	25cm	deep blue	7-8
3. Filler plants				
Catananche caerulea *	25	50-60cm	blue	7-8
Linum perenne *	25	50cm	blue	6-8
Lychnis (Silene) coronaria 'Alba' *	20	50cm	white	7-8
Scabiosa ochroleuca *	20	30-70cm	light yellow	7-9
4. Groundcovers				
Anemone sylvestris *	50	25-35cm	white	5-6
Calamintha nepeta subsp. Nepeta *	65	30cm	blue	6-8
Arabis caucasica	50	20cm	white	5-6
Geranium renardii *	60	10/20cm	white	6
Geranium sanguineum 'Album' *	60	20-40cm	white	6-8
Stachys byzantina 'Silver carpet' **	65	20/50cm	pink	7-8
Nepeta x faassenii *	50	25-30cm/30-60	light blue	6-8
5. Geophytes				
Allium nigrum *	150	70cm	white	6
Anemone blanda 'White Splendour' *	500	10-15cm	white	5-6
Crocus tommasinianus 'Ruby Giant' *	800	10-15cm	blue	5-6
Muscari latifolium *	400	20-30cm	blue	4-5
Tulipa praestans 'Füsilier' *	200	20cm	red	4-5

* original species
** alternative species from the original plant list

Plant choises

From the seven emerging plants in the original plant list, *Achillea filipendulina* 'Coronation Gold', *Sedum* 'Herbstfreude' and *Verbascum bombyciferum* are kept, since they are hardy and in cultivation in Finland (Alanko, 2007). *Stipa calamagrostis* 'Algäu' is also kept as it is also hardy and in cultivation (Alanko, 2007), but I use the new name *Achnatherum calamagrostis*. The other species; *Festuca mairei* and *Perovskia abrotanoides* are replaced, because of uncertainty about their hardiness. Alanko (2007) states that there is no experience of cultivating *Phlomis russeliana* in Finland, so it is replaced in the new mix with *Phlomis tuberosa*, which is the only *Phlomis* cultivated in Finland according to Alanko. *P. tuberosa* is similar to *P. russeliana* in that its stems stay upright after flowering. Alanko thinks however, that other plants in that genus could grow in this climate as well. *Sesleria heufleriana* replaces *Festuca* in the new mix. *Perovskia abrotanoides* is replaced by *Perovskia* 'Little Spire', which is available at some Finnish nurseries and very similar to the original species.

Out of the companion plants, four out of seven of the original species are kept; *Aster linosyris, Euphorbia polychroma (syn. E. epithymoides), Knautia macedonica and Veronia austrica ssp. teuricum* 'Knallblau' *(Veronica teucrium* 'Knallblau' according to the original plant list), since they are in cultivation and hardy in Finland according to Alanko (2007) and Särkkä and Ukonaho (1998). The rest of the species; *Anaphalis triplinervis* 'Silberregen', *Aster amellus* 'Sternkugel' and *Gaura lindheimeri*, are replaced due to uncertainty of hardiness and lack of availability. Instead of *Anaphalis triplinervis* 'Siberregen' the species *A. triplinervis* is used, since 'Siberregen' is not cultivated in nurseries in Finland (Alanko, 2007). *Aster amellus* 'Sternkugel' is replaced by *Aster sedifolius*, which was suggested as an alternative in the original plant mix. *A. sedifolius* is hardy and in cultivation according to Alanko (2007). *Gaura lindheimeri* is replaced by *Campanula persicifolia* 'Alba', which is hardy in Finland.

All filler plants are a part of the original Sibersommer mix. *Linum perenne, Lychnis coronaria* and *Scabiosa ochroleuca* are all in cultivation in Finland according to Alanko (2007). *Catananche caerulea* is available in several nurseries.

The groundcovers are also all, apart from two, a part of the original mix. *Anemone sylvestris, Calamintha nepeta subsp. Nepeta, Geranium renardii* and *sanguineum* and *Nepeta x faassenii* are hardy in Finland (Alanko, 2007). *Hieracium pilosella* 'Niveum' is replaced by *Stachys byzantina* 'Silver carpet', which is one of the alternative species suggested in the original plant list. *Stachys byzantina* 'Silver carpet' is hardy according to Alanko (2007). *Euphorbia cyparissas* is replaced by *Arabis caucasica*, since the *Euphorbia* is very competitive and might overpower the planting.

Out of the geophytes *Crocus tommasinianus* 'Ruby Giant' is a part of the original mix and hardy and cultivated in Finland (Särkkä & Ukonaho, 1998). *Allium nigrum, Anemone blanda* 'White Splendour', *Muscari latifolium* and *Tulipa praestans* 'Füsilier' are kept as in the original mix since they are available on the market in Finland.

Flowering chart

Scientific name	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
1.Emerging plants												
Achillea filipendulina 'Coronation Gold'												
Sesleria heufleriana												
Perovskia 'Little Spire'												
Phlomis tuberosa												
Sedum ’Herbstfreude’												
Achnatherum calamagrostis												
Verbascum bombyciferum												
2. Companion plants												
Anaphalis triplinervis												
Aster sedifolius												
Aster linosyris												
Euphorbia polychroma												
Campanula persicifolia 'Alba'												
Knautia macedonica												
Veronica austriaca ssp. teucrium 'Knallblau'												
3. Filler plants												
Catananche caerulea												
Linum perenne												
Lychnis (Silene) coronaria ‘Alba’												
Scabiosa ochroleuca												
4. Groundcovers												
Anemone sylvestris												
Calamintha nepeta subsp. Nepeta												
Arabis caucasica												
Geranium renardii												
Geranium sanguineum ’Album’												
Stachys byzantina 'Silver carpet'												
Nepeta x faassenii												
5. Geophytes												
Allium nigrum												
Anemone blanda 'White Splendour‘												
Crocus tommasinianus ‘Ruby Giant’												
Muscari latifolium												
Tulipa praestans ‘Füsilier’												

Pictures of the species in mix 1

Achillea filipendulina 'Coronation Gold'

Die Hohe Goldgarbe, lat. Achillea filipendulina 'Coronation Gold' 06 by Plenuska (CC BY-SA 4.0)

Sesleria heufleriana

Sesleria heufleriana Sesleria Heuflera 2018-04-15 01 by Agnieszka Kwiecień (CC BY-SA 4.0)

Perovskia 'Little Spire'

Perovskia atriplicifolia Little Spire 1zz by David Stang (CC BY-SA 4.0)

Phlomis tuberosa

Phlomis tuberosa sl23 by Stefan Lefnaer (CC BY-SA 4.0)

Sedum 'Herbsfreude'

Achnatherum calamagrostis

Stipa calamagrostis - Berlin Botanical Garden - IMG 8615 by Daderot (public domain)

Verbascum bombyciferum

Verbascum bombyciferum 7 by Ghislain Chenais (CC BY-SA 3.0, 2.5, 2.0, 1.0)

Anaphalis triplinervis

Anaphalis triplinervis 3 by Ghislain118 (CC BY-SA 3.0, 2.5, 2.0, 1.0)

Aster sedifolius

Aster sedifolius by Dinkum (public domain, CC0 1.0)

Aster linosyris

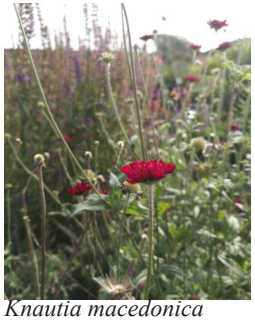
Aster linosyris, side-top view by Muscari (CC BY-SA 3.0)

Euphorbia polychroma

Euphorbia polychroma 01 by Andrey Korzun (CC BY-SA 3.0)

Campanula persicifolia 'Alba'

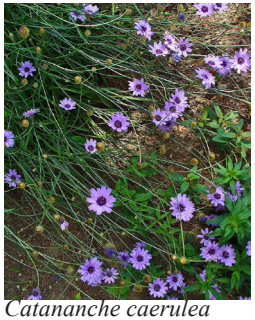
Perzikbladklokje2 by Bokske (CC BY-SA 3.0, 2.5, 2.0, 1.0)



Knautia macedonica

Veronica austriaca ssp. teucrium 'Knallblau'

Veronica austriaca 'Knallblau'-IMG 3612 by C T Johansson (CC BY-SA 3.0)



Catananche caerulea

Catananche caerulea 0001 by H. Zell (CC BY-SA 3.0)

Linum perenne

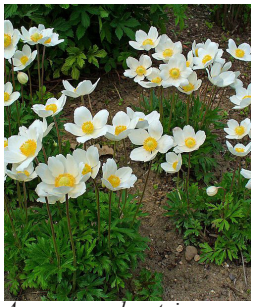
Linum perenne 4 by Ghislain118 (CC BY-SA 3.0, 2.5, 2.0, 1.0)

Lychnis coronaria 'Alba'

Lychnis coronaria 'Alba' by Leonora Enking (CC BY-SA 2.0)

Scabiosa ochroleuca

Scabiosa ochroleuca 2 by Franz Xaver (CC BY-SA 3.0)



Anemone sylvestris

Anemone sylvestris 001 by H. Zell (CC BY-SA 3.0)

Calamintha nepeta supsp. Nepeta

CalaminthaNepetaNepeta by Chhe (public domain)

Arabis caucasica

Arabis caucasica 02HD by DHochmayr (public domain)

Geranium renardii

Geranium renardii, Ooievaarsbek by Jakob Zweep (CC BY-SA 3.0)

Geranium sanguineum 'Album'

Geranium sanguineum Album 2015 01 by Agnieszka Kwiecień (CC BY-SA 4.0)

Stachys byzantina 'Silver carpet

Stachys byzantina Silver Carpet 0zz by David J. Stang (CC BY-SA 4.0)

Nepeta x faassenii

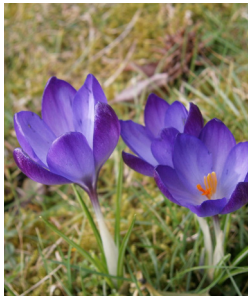
Nepeta x faassenii by A. Barra (CC BY 3.0)

Allium nigrum

Allium nigrum GotBot 2015 003 by Gustav Svensson (CC BY 3.0)

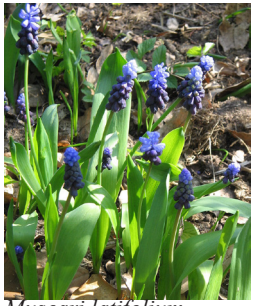
Anemone blanda 'White Splendour'

Anemone blanda 'White Splendour' at RHS Garden Hyde Hall, Essex, England 01 by Acabashi (CC BY-SA 4.0)



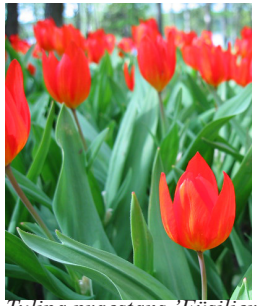
Crocus tommasinianus 'Ruby Giant'

Crocus tommasinianus Ruby Giant01 by Meneerke bloem (CC BY-SA 3.0, 2.5, 2.0, 1.0)



Muscari latifolium

Muscari latifoloum2 by Meneerke bloem (CC BY-SA 3.0, 2.5, 2.0, 1.0)



Tulipa praestans 'Füsilier'

Tulipa praestans 'fusilier' by Leo-setä (CC BY 2.0)

Mix 2: Kaino

based on Filigran (Filigree, See appendix B for the original plant list)

The name Kaino (literal translation coy) comes from this mix being more intriguing than what the first impression might give away.

Habitat: sunny to half-shade, dry

Examples of this kind of habitat: under trees close to traffic

Visual description: Green tones with subtle flowering

Management: Annual cutting back in early spring, some weeding might be needed in the first years after planting

Filigran was chosen to be further developed because it was one of the few mixes meant for dry locations below trees. This mix contains 12 different species; two emerging plants, three companion plants, two filler plants, two groundcovers and three geophytes.

Plant list

Scientific name	Amount/10m²	Height	Flower colour	Flowering time
1.Emerging plants				
Dryopteris filix-mas	3	50-100cm	-	-
Digitalis lutea *	10	70cm	light yellow	7-8
2. Companion plants				
Aruncus aethusifolius	8	20-30cm	white	7-8
Aster sedifolius *	5	60-80	blue	8-10
Geranium wlassovianum	5	40cm	purple	7-9
3. Filler plants				
Carex ornithopoda 'Variegata' *	18	15cm	-	
Anthericum liliago *	12	40-80cm	white	5-7
4. Groundcovers				
Geranium x cantabrigiense 'St. Ola' *	24	10-15cm	white	7-8
Potentilla tridentata 'Nuuk'	18	10/25cm	white	6-7
5. Geophytes				
Eranthis hyemalis **	150	10-12cm	yellow	4-5
Muscari latifolium *	150	20-30cm	blue	4-5
Crocus tommasinianus 'Ruby's Giant'	200	10-15cm	blue	5-6

* original species
** alternative species from the original plant list

Plant choises

In the original mix the emerging plants are two different species of *Digitalis, D. parviflora and D. lutea*. The latter is hardy and in cultivation in Finland (Alanko, 2007), but no record of *D. parviflora* being hardy was found. *Dryopteris filix-mas* replaces *D. parvifolia* in the mix.

Out of the original companion plants, *Aster sedifolius* is kept since it is hardy in Finland (Alanko, 2007) and it has actually been given the Finnish elite plant (Fin E) status (Luonnonvarakeskus, 2018). *Geranium sanguineum* ‘Khan’ is replaced by *Geranium wlassovianum*, since it is available on the market and hardy

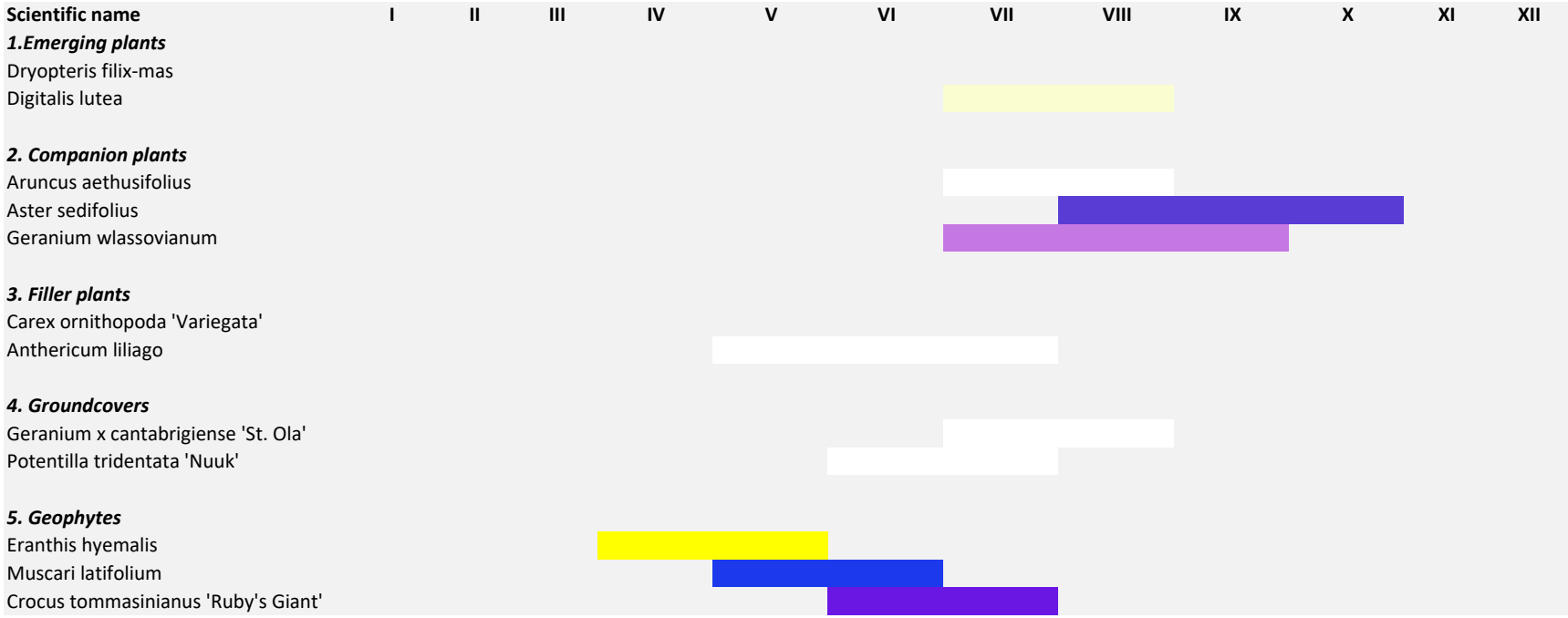
according to Särkkä & Ukonaho (1998) and has a similar growth habit to the original plant. *Sesleria autumnalis* is replaced by *Aruncus aethusifolius*, that grows well in this kind of habitat.

Both original filler plants are used in the new mix. *Carex ornithopoda* is hardy (Finnish Biodiversity Information Facility, 2019) and its cultival 'Variegata' is used in the mix. *Anthericum liliago* is also hardy (Alanko, 2007) and therefore a part of the mix.

From the groundcovers *Geranium x cantabrigiense* 'St. Ola' is a part of the original mix. The other original groundcover *Potentilla alba* is mentioned in Viljelykasvien nimistö, but it does not seem to be in cultivation in Finland, since it is not found in any nurseries in Finland. *P. alba* is replaced by *Potentilla tridentata* 'Nuuk', which is hardy (Särkkä & Ukonaho, 1998) and similar to the original species.

Out of the geophytes two original plants are used in the new mix. *Crocus tommansianus* 'Ruby Giant' is used instead of the species, since it is easier to find on the market. *Erantis cilicica* is replaced by *Eranthis hyemalis*, since it is easier to find on the market and is very similar to *E. clilicica*, and it is suggested as an alternative species in the original mix. *Muscari latifolium* is available on the market and remains a part of the mix.

Flowering chart



Pictures of the species in mix 2

Dryopteris filix-mas
Dryopteris filix-mas (8338376879) by Radio Tonreg (CC BY 2.0)

Digitalis lutea
Digitalis lutea by Joan Simon (CC BY-SA 2.0)

Aruncus aethusifolius
Aruncus aethusifolius GotBot 2015 003 by Gustav Svensson (CC BY 3.0)

Aster sedifolius
Aster sedifolius by Dinkum (public domain, CC0 1.0)

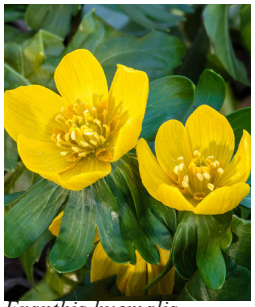
Geranium wlassovianum
Geranium wlassovianum kz05 by Krzysztof Ziarnek (CC BY-SA 4.0)

Carex ornithopoda 'Variegata'
Carex ornithopoda 'Variegata' kz1 by Krzysztof Ziarnek (CC BY-SA 4.0)

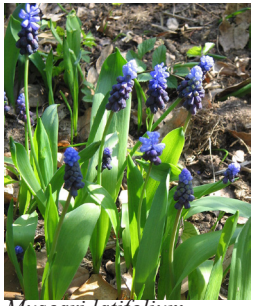
Anthericum liliago
Anthericum liliago by Meneerke bloem (CC BY-SA 3.0, 2.5, 2.0, 1.0)

Geranium x cantabrigiense 'St. Ola'
Файл:Geranium × cantabrigiense04 by Meneerke bloem (CC BY-SA 3.0, 2.5, 2.0, 1.0)

Potetilla tridentata 'Nuuk'
Potentilla tridentata by peganum (CC BY-SA 2.0)



Eranthis hyemalis
Winterakoniet (Eranthis hyemalis) (d.j.b.) by Dominicus Johannes Bergsma (CC BY-SA 4.0)



Muscari latifolium
Muscari latifoloum2 by Meneerke bloem (CC BY-SA 3.0, 2.5, 2.0, 1.0)

Crocus tommasinianus 'Ruby Giant'
Crocus tommasinianus Ruby Giant01 by Meneerke bloem (CC BY-SA 3.0, 2.5, 2.0, 1.0)

Mix 3: Onni

based on Präriemorgen (Prairie morning, See appendix C for the original plant list)

The name Onni (literal translation happiness) comes from this mix being a colourful tall planting giving joy to the viewer.

Habitat: full sun, well-drained

Examples of this kind of habitat: roundabouts, traffic islands

Visual description: Colourful tall planting, with a focus on late summer flowering

Management: Annual cutting back in early spring , some weeding might be needed in the first years after planting

Präriemorgen was chosen as one of the mixes because it is visually very different from Silbersommer, even though they are suitable for the same kinds of locations. I wanted to include another option for dry open spaces and this mix is suitable for smaller areas (≥20 m²) than Silbersommer (≥30 m²). This mix has 22 species; four emerging plants, eight companion plants, two filler plants, four groundcovers and four geophytes.

Plant list

Scientific name	Amount/100m²	Height	Flower colour	Flowering time
1.Emerging plants				
Perovskia 'Little Spire'	25	45-60cm	blue	8-9
Eryngium planum	20	80cm	blue	7-8
Anaphalis margaritacea	10	30-60/50-80cm	white	7-9
Lychnis chalcedonica	30	100cm	red	7-8
2. Companion plants				
Aster novae-angliae 'Purple Dome' *	25	40-45cm	purple	9-10
Campanula persicifolia	10	80-100cm	blue	7-8
Arnebia pulcra	60	30-40cm	yellow	6
Echinacea pallida *	30	90cm	pink	6-9
Liatris spicata *	70	60cm	purple	7-9
Stipa pennata	50	30/50cm	-	6-7
Monarda fistulosa	25	60-90cm	light purple	7-9
Origanum vulgare	30	50cm	purple red	7-8
3. Filler plants				
Linum perenne *	25	50cm	blue	6-8
Monarda punctata *	15	30-60cm	light purple	7-8
4. Groundcovers				
Veronica spicata	200	40-80cm	blue	7-8
Aster ptarmicoides var. Lutescens *	100	40-50cm	white	9-10
Penstemon hirsutus *	65	40-60 cm	light purple	6
Artemisia ludoviciana 'Silver Queen' *	10	70m	white	6-8
5. Geophytes				
Allium cernuum *	200	30cm	pink	6-8
Anemone blanda 'Blue Shades' *	500	10-15cm	blue	5-6
Tulipa praestans 'Tubergen's Variety' *	100	25cm	red	5-6
Narcissus 'Thalia'	200	30-40cm	white	5-6

* original species

Plant choises

In this mix all emerging plants from the original mix are substituted, since none of them are hardy or available in Finland. *Amorpha canescens* is replaced by *Perovskia* 'Little Spire', which is suggested as an alternative species for the *Amorpha* in the original plant list. *Eryngium yuccifolium* is replaced by a hardy *Eryngium planum*, also suitable for dry environments. A*naphalis margaritacea* replaces *Perovskia abrotanoides* in the mix, it is ideal for this habitat. *Schizachyrium scoparium 'Cairo'* is replaced by *Lychnis chalcedonica*, even though they do not share the same look, *Lychnis* also enjoys growing in this kind of habitat.

Out of eight companion plants, three belong to the original mix; *Aster novae-angliae* 'Purple Dome', *Echinacea pallida* and *Liatris spicata*, all hardy and in cultivation according to Alanko (2007). *Campanula persicifolia* is replacing *Gaura lindheimeri* 'Elfenspiegel' from the original mix. *C. persicifolia* is a beautifully flowering native species. Instead of *Nassella tenuissima, Stipa pennata* is used in the new mix. *Echinacea tennesseesis* 'Rocky Top Hybrids' is replaced by *Arnebia pulcra*, a long-flowering hardy perennial. *Monarda fistulosa* is used instead of *M. fistulosa var. menthifolia*, since *M.fistulosa* is available on the market. *Pycnanthemum tenuifolium* is replaced with *Origanum vulgare,* since it is better available on the market and also grows well in sunny and dry locations.

Both filler plants, *Linum perenne* and *Monarda punctata*, are also a part of the original mix and are hardy and in cultivation in Finland (Alanko, 2007).

Out of the groundcovers, only one of them is hardy and in cultivation; *Artemisia ludoviciana var. albula* 'Silver Queen' (Alanko, 2007). *Bouteloua gracilis* is replaced by *Veronica spicata*, a hardy perennial suitable for this habitat. *B. gracilis* is cultivated in Finland as an annual, even though it is a perennial, and does not always flower at the end of cold summers (Nyman, 2008). *Aster ptarmicoides var. lutescens* is used instead of *A. ptarmicoides*, but it is quite rare on the market (Alanko, 2007).

Out of the four geophytes that are a part of the original mix, three are kept in the renewed mix. *Allium cernuum* is hardy (Särkkä & Ukonaho, 1998) and available on the market. *Anemone blanda* 'Blue Shades' is also kept from the original mix, as it is available on the market in Finland. *Tulipa praestans* 'Tubergen's Variety' is also available and therefore kept in the mix. *Narcissus* 'Thalia' replaces *Narcissus triandrus* 'Petrel', since it similar but easier to acquire.

Flowering chart

Scientific name	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
1.Emerging plants												
Perovskia 'Little Spire'												
Eryngium planum												
Anaphalis margaritacea												
Lychnis chalcedonica												
2. Companion plants												
Aster novae-angliae 'Purple Dome'												
Campanula persicifolia												
Arnebia pulcra												
Echinacea pallida												
Liatris spicata												
Stipa pennata												
Monarda fistulosa												
Origanum vulgare												
3. Filler plants												
Linum perenne												
Monarda punctata												
4. Groundcovers												
Veronica spicata												
Aster ptarmicoides var. Lutescens												
Penstemon hirsutus												
Artemisia ludoviciana 'Silver Queen'												
5. Geophytes												
Allium cernuum												
Anemone blanda 'Blue Shades'												
Tulipa praestans 'Tubergen's Variety'												
Narcissus 'Thalia'												

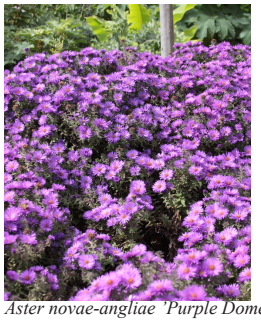
Pictures of the species in mix 3

Perovskia 'Little Spire'
Perovskia atriplicifolia Little Spire 1zz by David Stang (CC BY-SA 4.0)

Eryngium planum
Eryngium planum (habitus) 1 by Le.Loup.Gris (CC BY-SA 3.0)

Anaphalis margaritacea
Anaphalis margaritacea 001 by H. Zell (CC BY-SA 3.0)

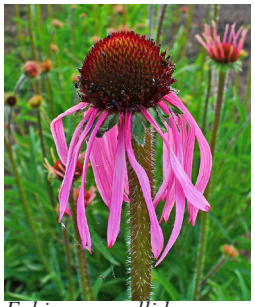
Lychnis chalcedonica
Lychnis chalcedonica A by Wouter Hagens (public domain)



Aster novae-angliae 'Purple Dome'
New England Aster 'Purple Dome' (symphyotrichum novaeangliae} by Drew Avery (CC BY 2.0)

Campanula persicifolia
Campanula persicifolia flowers 2 by Marinka kma (CC BY-SA 4.0)

Arnebia pulchra
Arnebia pulchra kz1 by Krzysztof Ziarnek (CC BY-SA 4.0)

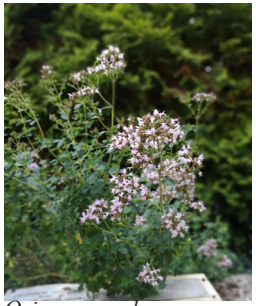


Echinacea pallida
Echinacea pallida 002 by H. Zell (CC BY-SA 3.0)

Liatris spicata
Liatris spicata 2018-07-09 5005 by Salicyna (CC BY-SA 4.0)

Stipa pennata
Stipa pennata 001 by Meneerke bloem (CC BY-SA 3.0, 2.5, 2.0, 1.0)

Monarda fistulosa
Wild Bergamots by USFWS Mountain-Prairie (CC BY 2.0)



Origanum vulgare

Linum perenne
Linum perenne 4 by Ghislain118 (CC BY-SA 3.0, 2.5, 2.0, 1.0)

Monarda punctata
Monarda punctata (spotted beebalm), Native Plant Garden, NYBG by Kristine Paulus (CC BY 2.0)

Veronica spicata
Veronica spicata01 by Meneerke bloem (CC BY-SA 3.0, 2.5, 2.0, 1.0)

Aster pratmicoides var. Lutescens

Aster ptarmicoides GotBot 2015 001 by Gustav Svensson (CC BY 4.0)

Penstemon hirsutus

Penstemon hirsutus - Hairy Beard Tongue 2 by Fritzflohrreynolds (CC BY-SA 3.0)

Artemisia ludoviciana 'Silver Queen'

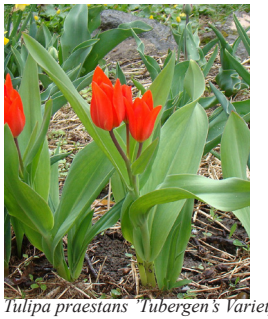
Artemisia ludoviciana by Matt Lavin (CC BY-SA 2.0)

Allium cernuum

Allium cernuum - Nodding Onion 3 by Fritzflohrreynolds (CC BY-SA 3.0)

Anemone blanda 'Blue Shades'

Anemone blanda MS 0152 by Marco Schmidt (CC BY-SA 3.0)



Tulipa praestans 'Tubergen's Variety'

Tulipa praestans 'Van Tubergen's variety' Y001 by Ю. Данилевский (CC BY-SA 3.0, 2.5, 2.0, 1.0)

Narcissus 'Thalia'

Triandrus Daffodil, Narcissus "Thalia" Amaryllidaceae by Ryan Somma (CC BY 2.0)

Mix 4: Kaiho

based on Blütenmosaik (Flower mosaic, see appendix D for the original plant list)

The name Kaiho (literal translation nostalgia) represents the feeling this planting gives.

Habitat: dry to moderately dry soil, sunny

Examples of this kind of habitat: traffic islands

Visual description: low growing or mid-height species, different yellow tones with some purple

Management: Annual cutting back in early spring , some weeding might be needed in the first years after planting

Blütenmosaik was chosen since it is a mix with shorter species, suitable for traffic areas where the vegetation cannot be so tall because of good visibility while driving. The mix can also be used on green roofs, with at least 15 cm of substrate. This mix contains 13 species, one emerging plant, four companion plants, one filler plant, four groundcovers and three geophytes.

Plant list

Scientific name	Amount/100m²	Height	Flower colour	Flowering time
1.Emerging plants				
Aster sedifolius 'Nanus' *	100	30cm	purple	8-9
2. Companion plants				
Aster linosyris *	50	40cm	yellow	7-9
Campanula carpatica 'Weisse Clips'	60	15-20cm	white	7-8
Festuca amethystina *	100	20cm	-	
Linum flavum *	150	40cm	yellow	7-8
3. Filler plants				
Papaver radicatum	100	5/20cm	light yellow	5-7
4. Groundcovers				
Geranium sanguineum var. striatum *	100	20cm	pink	7-8
Nepeta x faassenii *	80	25-30cm	light blue	7-8
Sedum floriferum	120	20cm	yellow	8-9
Thymus pulegioides *	150	15cm	purple	7
5. Geophytes				
Crocus chrystanthus 'Romance'	1000	10 cm	yellow	4-5
Muscari aucheri 'White Magic'	500	15cm	white	5
Tulipa tarda *	500	20cm	white-yellow	5

* original species

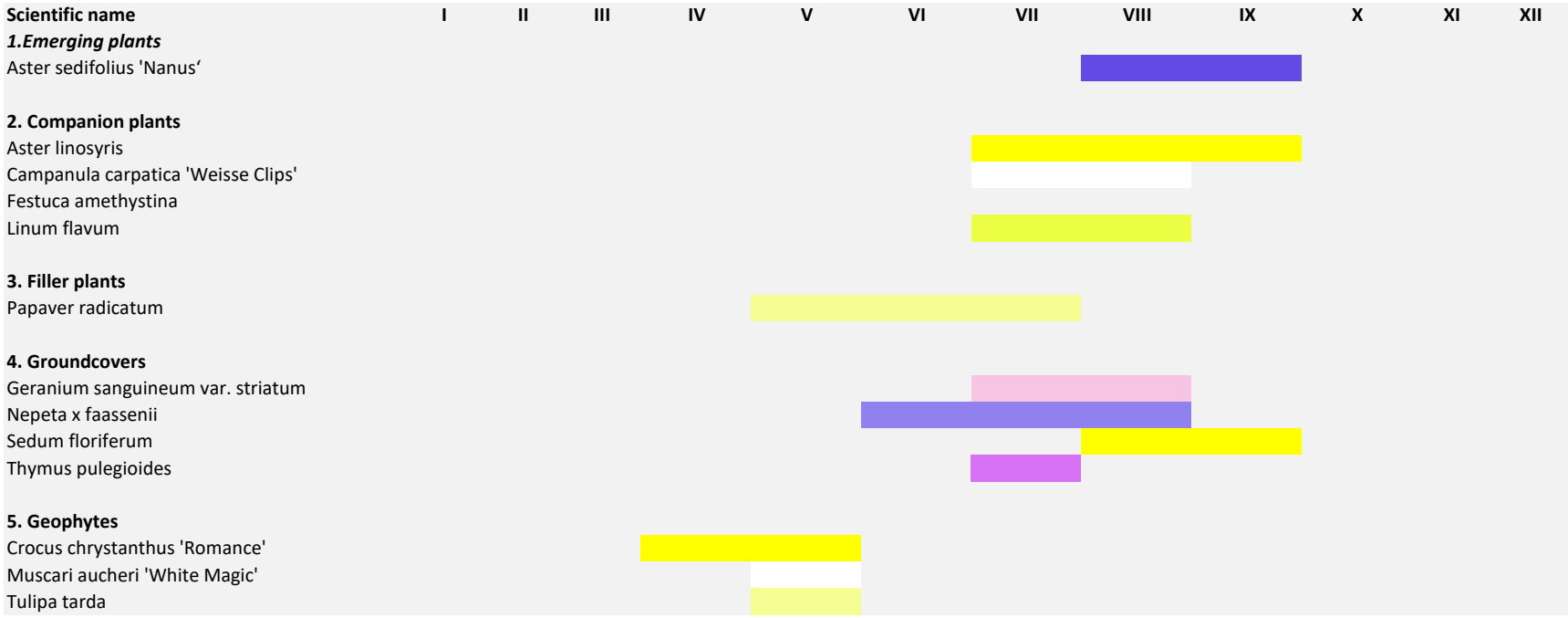
Plant choises

All emerging plants, companion plants, filler plants and groundcovers from the original mix are hardy in Finland and available on the market. However, I chose to exchange a few species. From the companion plants, I decided to exchange *Campanula persicifolia* (already a part of two other mixes), to *Campanula carpatica* 'Weisse Clips'. It is shorter than *C. persicifolia*, which makes it more suitable for this mix that is meant to be low. The filler plant *Linum perenne* is replaced, since it is also a part of two of the other mixes. Instead of *Linum*, *Papaver radicatum* is used.

Out of the groundcovers *Geranium sanguineum* 'Lancastriense' was substituted for the current name of the same plant *Geranium sanguineum var. stiatum*.

Out of the geophytes, *Crocus chrystanthus* was substituted for *Crocus chrystantus* 'Romance', since it is easier to find on the market in Finland.

Flowering chart



Pictures of the species in mix 4

Aster sedifolius 'Nanus'
Aster sedifolius 'Nanus' Aster wąskolistny 2017-10-15 02 by Agnieszka Kwiecień (CC BY-SA 4.0)

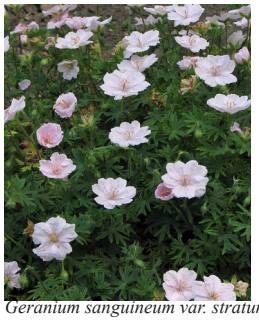
Aster linosyris
Aster linosyris, side-top view by Muscari (CC BY-SA 3.0)

Campanula carpatica 'Weisse Clips'
Campanula carpatica Weisse Clips by Qwertzy2 (CC BY-SA 3.0)

Festuca amethystina
Festuca amethystina - Berlin Botanical Garden - IMG 8537 by Daderot (public domain)

Linum flavum
Linum flavum sl14 by Stefan Lefnaer (CC BY-SA 4.0)

Papaver radicatum
Arctic Poppy 2001-07-16 by Ansgar Walk (CC BY-SA 3.0)



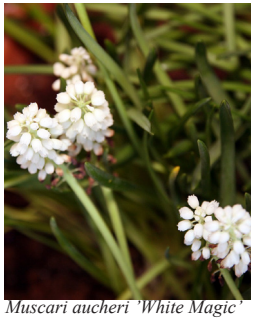
Geranium sanguineum var. stratum
Geranium sanguineum var. striatum Bodziszek czerwony 2010-06-11 01 by Agnieszka Kwiecień (CC BY-SA 4.0)

Nepeta x faassenii
Nepeta x faassenii by A. Barra (CC BY 3.0)

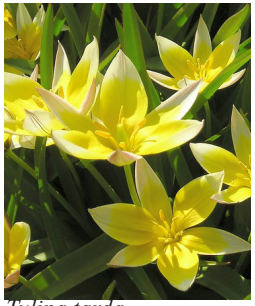
Sedum floriferum
SedumFloriferum by Mussklprozz (CC BY-SA 3.0)

Thymus pulgeoides
Thymus pulegioides by LuckyLion (CC BY 3.0)

Crocus chrysanthus 'Romance'
Crocus chrysanthus Romance1 by Meneerke bloem (CC BY-SA 3.0, 2.5, 2.0, 1.0)



Muscari aucheri 'White Magic'
Muscari White Magic 1zz by David J. Stang (CC BY-SA 4.0)



Tulipa tarda
Späte Tulpe (Tulipa tarda) by Maja Dumat (CC BY 2.0)

6 Dicussion and conclusions

Review of the literature study

Review of the mixes

Future development

Conclusion

In this chapter the results of the work are discussed. The aim of this thesis was to find suggestions of mainly herbaceous plant combinations for challenging urban habitats in southern Finland. The research question was "Which plant combinations can be used to get dynamic herbaceous long-lasting plantings in challenging urban habitats?". These together guided the process of this work, from understanding what is needed to create designed plant communities to adapting the knowledge when working with the mixes. The result became four perennial mixes, that can be used in the conditions they are meant for: all mixes are suitable for dry areas, three for full-sun and one for half-shade. One of the mixes for full sun is low-growing. The focus was on challenging conditions in urban areas, such as plantings close to traffic, but these mixes can be used anywhere where the soil and light conditions are met.

Review of the literature study

The literature review presented the basic ideas behind designed plant communities and how they differ from so-called traditional perennial plantings. This serves as an overview of the concept, even though the ideal situation would be to learn more by trying these principles in real life, to better understand the complexity of the subject. The German mixes, that formed the base of the renewed ones, were an important resource, since they have been trialled and tested by professionals several times. These kinds of ready-made mixes save time, so that any designer knowing the conditions of their design area, can choose a mix without having to invest so much time in creating new plant combinations or going for the boring solution: mass plantings.

There are some other randomly mixed planting strategies that are worth mentioning. The Sheffield School, James Hitchmough's and Nigel Dunnett's planting design ideas would be another interesting topic to investigate. The focus there is more on seed mixtures, which take a longer time to develop, but when they do, actually create a completely ecologically functioning community (Dunnet *et al*., 2004). Seed mixtures could be used in areas where there is not such big pressure to get instant results, in suburban areas for example. Seeds are more cost-effective than planted perennials in larger areas.

As mentioned briefly in the part about the mixed planting system, for example in Switzerland they have created their own mixes. Different companies in these German speaking countries have also created their own mixes and adapted some of the existing ones. A lot of variations have been made of Silbersommer. It is good that the research that has been made to create these mixes is used to find new plant combinations. Hopefully this idea of mixed plantings will spread even further, so that we get more results from different climates and with other species.

This thesis focused on dry urban areas, but of course urban areas contain a lot of other kinds of habitats. Extreme weather phenomena such as heavy rainfalls require plantings that can take extreme wetness from time to time. The mixes that were created are all for more or less well-drained soil, which would also drain heavy rainfalls faster than many other soils.

Looking back at the literature review, the part about the climate in Finland might not seem so relevant, when the hardiness of perennials is based more on the right conditions in the particular spot where they are growing. Defining hardiness can also be difficult in other ways. As we learned by Kingsbury (2014),

shade-tolerant plants can tolerate more light in northern areas, which means that we cannot blindly trust the suitability of a plant based on its native growing conditions. But there is still a connection between climate and perennial hardiness, and that is a part of the reason why this work is limited to southern Finland. In the northern parts of the country the growing season is much shorter, and some late flowering species would not have time to flower there. All in all, the meaning with focusing on southern Finland had more to do with the fact that most of the big cities in Finland are in the southern parts of the country. This means that the challenging urban conditions are more likely to occur in the south as well.

A lot of plant-related literature is for private gardeners made by private gardeners and the information there cannot always be trusted. The literature used in this thesis was carefully chosen, and such ”hobby” -literature was avoided.

Review of the mixes

Even though there were the German mixes to rely on as a base, there was still a lot of work to be done when creating the renewed mixes. The first step was actually to choose which mixes to redevelop. The chosen mixes are the only ones that were looked deeper into, so among the rest there are probably many more that could be utilised. When looking at the actual plants in the mixes it seemed as though the structural or emerging plants were the ones that are not suitable for the Finnish climate. This can be due to the fact that they are more “showy” plants that are from more exotic regions. This was especially true for Prärieмorgen, the base for mix 3, Onni. A lot of species had to be replaced, which made it the hardest one to create. This is probably because most of the plants originate from the prairie and are either not hardy in Finland or have not found their way to the market here. As for the “easiest” one, Blütenmosaik turned out to be the most suitable as it is for the Finnish climate. Almost all species in the original mix are hardy and in cultivation in Finland.

One problem when trying to figure out which species are hardy, is that hardiness is not that easily defined. A lot depends on the right growing conditions and microclimate. It also seems as though perennials haven’t been that popular in cultivation compared to some other countries, which means there probably are a lot of plants that would be hardy that have never been tried in Finland or tried in the wrong kinds of conditions. Some of the plants that were in the German mixes I decided to replace, since the plants are not available in Finland and their hardiness is therefore uncertain. This is however not how we would get experience of plants that have not yet been tried in Finland, but that would be another kind of work completely.

When looking for substituting plants for the non-hardy or non-available plants in the mixes, there were different ways of trying to find the right plant. In some cases, it was important to find a visually similar species. But in most cases, it became more relevant to find any suitable plant for the specific category for the specific habitat, without thinking about the similarity in looks. This had to do with the fact that it was more important to make sure that the mix would function as a community. But visual appearance cannot be completely forgotten, since it is important to also create visually appealing plantings to get public acceptance.

One slightly unexpected challenge came up when looking up the plants in the German mixes. Some of the plant names were

different in the plant list than in the reference literature. This made it harder to assess the hardiness and availability, since sometimes the problem was only that the plant was called something different in the literature and nurseries. Name changes are quite common for plants, their names are changed because they are for example found to belong to a different genus.

To be able to know if these mixes work, they would have to be trialled. This work would have benefitted from having the opportunity to try the mixes in real life, but that would take too much time to do. One could argue that there is no way of actually knowing if the mixes would work, since the new species are added based on theoretical assumptions. However, the original mixes have been trialled several times, and the new species were chosen with care.

Plant hardiness is difficult to find out since all species have not been trialled yet. Some Swedish references could have been used to get more information about species hardiness in a similar climate, but it turned out to be a quite time-consuming work to check the Finnish references, so that was not done. The main source of information regarding the plant hardiness and availability in Finland came from the 2007 book *Perennat* by Pentti Alanko. The book might be a bit outdated, but there was no better more recent source available. Nursery plant lists were used to complement the information found in the literature.

Future development

The best way to test if the mixes developed in this work would succeed, is to have them planted in the habitats they were developed for and see how they perform and develop in Finland. This of course would require some financing from for example a city like Helsinki, that has previously trialled some designed plant communities. Locations for these kinds of plantings should not be hard to find, they are common in all urban areas.

It seems like the future for designed plant communities is bright in Finland. There have been some publicly invested trials and research going on to investigate the opportunities for designed plant communities. As in Germany, the Nursery Association in Finland could support the development of new mixes with the help of universities and other research institutions. This way there would be someone making sure that the plants would be available at nurseries.

One major factor in the future development became very clear during this work, which is that without having trying plants in a similar environment as they originate from, there is no way of knowing if the plants would succeed in a specific climate. There needs to be more willingness to try out new plants in the public sector. As always, this becomes a question of money, who is ready to invest in developing the perennial market in Finland? The German mixes could be trialled as they are and perhaps some new species to Finland would prove to be successful. Hansen and Stahl state that “It is always dangerous to give recipes for successful planting” (1993, p. 35). However, without trying new things, in this case new plant combinations, there is no way of learning if we are right or wrong.

Conclusion

This thesis discussed the potential to use ready-made perennial mixes, based on the German mixed planting system, in public areas especially close to traffic, where low-maintenance plantings are desired. Designed plant communities are gaining popularity in Finland and during the recent years there has been a growing interest to learn more about the potential of designed plant communities in public use. The prospect of getting diverse plantings that require less time to manage is appealing to many in the public sector. With the help of plant mixes, like the ones developed in Germany, some valuable designing time (and money) is saved.

The question that I wanted to answer in this work (Which plant combinations can be used to get dynamic herbaceous long-lasting plantings in challenging urban habitats?) has been answered by four plant mixes created with the German mixed planting system as a base. The new mixes developed from Silbersommer, Filigran, Prärieмorgen and Blütenmosaik have not yet been trialled to make sure they work, but the first step has been taken by suggesting these specific species together.

This ecological style of planting with mixed species is becoming more and more popular, it can be seen in the amount of literature from the recent years compared to some decades ago. It can also be seen in public plantings in many western countries. I hope this work can provide readers with an introduction to designed plant communities and help them choose plants based on site conditions. I also intend to use this work as a tool myself in my career as a landscape architect and hope to develop an even deeper understanding of the ecology of urban plant communities.

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Image references

(of the plants in the mixes in order of appearance)

plant images not listed here are taken by the author

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Mix 3:

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Lavin, M. (2009). Artemisia ludoviciana [photography]. https://www.flickr.com/photos/plant_diversity/4022881472/ [6.8.2019]

Allium cernuum

Fritzflohrreynolds (2013). Allium cernuum - Nodding Onion 3 [photography]. https://commons.wikimedia.org/wiki/File:Allium_cernuum_-_Nodding_Onion_3.jpg [6.8.2019]

Anemone blanda 'Blue Shades'

Schmidt, M. (2009). Anemone blanda MS 0152 [photography]. https://commons.wikimedia.org/wiki/File:Anemone_blanda_MS_0152.jpg [6.8.2019]

Tulipa praestans 'Tubergen's Variety'

Ю. Данилевский (2015). Tulipa praestans 'Van Tubergen's variety' Y001 [photography]. https://commons.wikimedia.org/wiki/File:Tulipa_praestans_%27Van_Tubergen%E2%80%99s_variety%27_Y001.jpg [6.8.2019]

Narcissus 'Thalia'

Somma, R. (1980). Triandrus Daffodil, Narcissus "Thalia" Amaryllidaceae [photography]. https://www.flickr.com/photos/ideonexus/6086406999 [6.8.2019]

Mix 4:

Aster sedifolius 'Nanus'

Kwiecień, A. (2017). Aster sedifolius 'Nanus' Aster wąskolistny 2017-10-15 02 [photography]. https://commons.wikimedia.org/wiki/File:Aster_sedifolius_%27Nanus%27_Aster_w%C4%85skolistny_2017-10-15_02.jpg [10.7.2019]

Aster linosyris

Muscari (2008). Aster linosyris, side-top view [photography]. https://commons.wikimedia.org/wiki/File:Aster_linosyris,_side-top_view.jpg [10.7.2019]

Campanula carpatica ‘Weisse Clips’

Qwertzy2 (2005). Campanula carpatica Weisse Clips [photography]. https://commons.wikimedia.org/wiki/File:Campanula_carpatica_Weisse_Clips.JPG [18.8.2019]

Festuca amethystina

Daderot (2010). Festuca amethystina - Berlin Botanical Garden - IMG 8537 [photography]. https://commons.wikimedia.org/wiki/File:Festuca_amethystina_-_Berlin_Botanical_Garden_-_IMG_8537.JPG [10.7.2019]

Linum flavum

Lefnaer, S. (2015). Linum flavum sl14 [photography]. https://commons.wikimedia.org/wiki/File:Linum_flavum_sl14.jpg [10.7.2019]

Papaver radiactum

Walk, A. (2001). Arctic Poppy 2001-07-16 [photography]. https://fi.wikipedia.org/wiki/Tiedosto:Arctic_Poppy_2001-07-16.jpg [18.8.2019]

Geranium sanguineum var. striatum

Kwiecień, A. (2010). Geranium sanguineum var. striatum Bodziszek czerwony 2010-06-11 01 [photography]. https://commons.wikimedia.org/wiki/File:Geranium_sanguineum_var._striatum_Bodziszek_czerwony_2010-06-11_01.jpg [18.8.2019]

Nepeta x faassenii

Barra, A. (2008). Nepeta x faassenii [photography]. https://commons.wikimedia.org/wiki/File:Nepeta_x_faassenii.jpg [4.8.2019]

Sedum floriferum

Mussklprozz (2004). SedumFloriferum [photography].https://de.wikipedia.org/wiki/Datei:SedumFloriferum.jpg [1.9.2019]

Thymus pulegioides

LuckyLion (2008). Thymus pulegioides [photography]. https://commons.wikimedia.org/wiki/File:Thymus_pulegioides.jpg [18.8.2019]

Crocus chrysanthus ‘Romance’

Meneerke bloem (2011). Crocus chrysanthus Romance1 [photography]. https://commons.wikimedia.org/wiki/File:Crocus_chrysanthus_Romance1.jpg [18.8.2019]

Muscari aucheri ’White Magic’

Stang, D.J. (2008). Muscari White Magic 1zz [photography]. https://commons.wikimedia.org/wiki/File:Muscari_White_Magic_1zz.jpg [18.8.2019]

Tulipa tarda

Dumat, M. Späte Tulpe (Tulipa tarda) [photography]. https://www.flickr.com/photos/blumenbiene/5456695264/ [18.8.2019]

Standort: *trocken, gut durchlässig, Problemstandort* **Licht:** *sonnig* **Farbe:** *v.a. blaue, weiße u. gelbe Blüten, silbriges Laub*
Anwendungsgebiete: *u.a. Verkehrsbegleitgrün, Parks, Wohnungsbau, Hausgarten; Mindestgröße der Pflanzfläche: 30 m²*
Pflege: *bodennaher Komplett-Rückschnitt im Spätwinter vor Austreiben der Zwiebelpflanzen, individuell Rückschnitt des Festuca*

Silbersommer

Artenliste und Charakteristik

Name (botanisch - deutsch)	Stück/100 m² (empfohlener Mengenanteil)	Hinweise (W: Winterwirkung durch Strukturen und Texturen oder wintergrüne Belaubung)	Alternativart/-sorte
1. Gerüstbildner			
Achillea filipendulina 'Coronation Gold' Gold-Garbe	*20*	*silbergraues Blattwerk, gelbe Blütenscheiben ab Juni bis Oktober, [W]*	
Festuca mairei Atlas-Schwingel	*10*	*monumentales Horstgras, dünne, elegant übergeigende Halme, [W]; Rückschnitt im zeitigen Frühjahr individuell auf 15 - 20 cm*	*Panicum virgatum ‚Heavy Metal' (straff aufrecht, grau-grünes Laub, gelbe Herbstfärbung) oder Calamagrostis x acutiflora ‚Overdam' (panaschiertes Laub)*
Perovskia abrotanoides Perovskie, Blauraute	*10*	*weißfilzige Triebe und Blätter; lange blaue Blüte im Sommer, Halbstrauch*	
Phlomis russeliana Brandkraut	*10*	*wintergrüner Blattteppich, langlebige Struktur durch mehrstöckige Blüten- (gelb, ab Juni) und Fruchtquirle [W]*	
Sedum telephium 'Herbstfreude' Purpur-Fetthenne	*25*	*rotbraune Blütenteller im Spätsommer, Bienenpflanze [W]*	*S. ‚Matrona' (rötliches Laub)*
Stipa calamagrostis ‚Algäu' (Syn. Achnatherum calamagrostis) Silber-Ährengras, Alpen-Raugras, Föngras	*10*	*straff aufrechtes Gras, locker überhängende Rispen, legen sich vorübergehend nieder, schöne Wirkung von Juni bis Februar [W]*	*Stipa calamagrostis ‚Lemperg' (reichblütig, rötliche Herbstfärbung)*
Verbascum bombyciferum Seidenhaar-Königskerze	*10*	*markante Gestalt, langblühend, zweijährig, versamt sich, wenn genügend offene Stellen vorhanden [W]*	*V. chaixii ‚Album' (ausdauernd)*
2. Begleitstauden			
Anaphalis triplinervis 'Silberregen' Himalaya-Perlkörbchen	*35*	*Blüten und Blattwerk silbergrau*	*25 Stachys byzantina 'Cotton Boll'*
Aster amellus 'Stemkugel' Berg-Aster	*35*	*blauvioletter, kompakter Herbstblüher; auf Sandböden Alternativ-Arten verwenden*	*A. novae-angliae ‚Purple Dome', 30 A. pyrenaeus ‚Lutetia', A. sedifolius*
Aster linosyris - Goldhaar-Aster	*35*	*gelber Spätsommerblüher, feine Textur durch lineare Blätter*	
Euphorbia epithymoides (Syn. Euphorbia polychroma) - Bunte Wolfsmilch	*35*	*halbkugelige Wuchsform; gelbe Blüte im Mai, rote Herbstfärbung*	
Gaura lindheimeri Prachtkerze	*20*	*weiße Blütenschleier von Juni bis Oktober, erhält sich durch Selbstaussaat*	
Knautia macedonica - Rote Witwenblume	*35*	*Langblüher (apartes Weinrot), mäßig langlebig, Selbstaussaat*	
Veronica teucrium ‚Knallblau' Großer Ehrenpreis	*35*	*sehr auffällig zur Blütezeit durch intensives Blau*	*V. teucrium ‚Kapitän'*
3. Füllpflanzen			
Catananche caerulea - Rasselblume	*25*	*blauer Langblüher, kurzlebig, Selbstaussaat*	
Linum perenne - Blauer Stauden-Lein	*25*	*blauer Frühsommerblüher, kurzlebig, Selbstaussaat in Lücken*	
Lychnis (Silene) coronaria 'Alba' Weiße Vexiernelke	*20*	*weißfilzig und weiß blühend, silbergraue Rosetten, kurzlebig, aber reich versamend*	
Scabiosa ochroleuca - Gelbe Skabiose	*20*	*blassgelber Dauerblüher, kurzlebig, aber reich versamend*	
4. Bodendecker			
Anemone sylvestris Hain-Anemone, Großes Windröschen	*50*	*flächige Ausbreitung durch Wurzelsprosse, weiße Schalenblüten im Mai bis Juni, nicht für Sandböden*	
Calamintha nepeta subsp. Nepeta Bergminze, Steinquendel	*65*	*blasslila Blütenschleier, lang anhaltende späte Blüte, aromatisch, Bienenpflanze; Nur diese sterile Form verwenden!*	
Euphorbia cyparissias Zypressen-Wolfsmilch	*50*	*gelbgrüne Blütenstände (April) über fein texturiertem Laub (im Herbst gelb); aus weit streichenden Wurzeln sprossend, aber verträglich*	*E.cyparissias 'Fens Ruby', rot austreibend, etwas schwächer im Wuchs*
Geranium renardii Kaukasus-Storchschnabel	*60*	*graugrüne Blätter mit genarbter Oberfläche, im Herbst z.T. orangerot; Verjüngung durch Versamung*	*50 G. renardii 'Terre Franche', 60 G. x cantabrigiense 'Saint Ola'*
Geranium sanguineum 'Album' Weißer Blut-Storchschnabel	*60*	*feingliedriges Laub und weiße Blüten geben der Pflanzung eine duftige Note; Nur diese sterile Sorte verwenden!*	
Hieracium pilosella 'Niveum' Kleines Habichtskraut	*65*	*ganz niedriger Teppich, Blüten zitronengelb; Nur diese Sorte mit silbergrauen Blättern verwenden!*	*50 Stachys byzantina ‚Sheila McQueen' oder ‚Silver Carpet'*
Nepeta x faassenii - Blaue Katzenminze	*50*	*graufilzig, reich und lang blau blühend*	

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Silbersommer

Artenliste und Charakteristik

Name *(botanisch - deutsch)*	Stück/100 m² *(empfohlener Mengenanteil)*	Hinweise *(W: Winterwirkung durch Strukturen und Texturen oder wintergrüne Belaubung)*	Alternativart/-sorte
5. Blumenzwiebeln und -knollen; Pflanzung im Herbst			
Allium nigrum *Schwarzer Lauch*	*150*	*eine der zuverlässigsten Zierlauch-Arten mit weißen Blüten in halbkugeliger Dolde; einzeln oder in kleinen Gruppen*	*200 Allium atropurpureum*
Anemone blanda ‚White Splendour' *Weißes Balkan-Windröschen*	*500*	*weißer Blütenteppich im April, wüchsige, sterile Sorte mit langer Blütezeit; im Mai einziehend; in Tuffs zu 3 bis 5*	*A. blanda 'Blue Shades' (blau)*
Crocus tommasinianus 'Ruby Giant' *Dalmatiner-Krokus, Elfen-Krokus*	*800*	*einer der frühesten Krokusse, reich blühend, purpurviolett, steril, wüchsig; in Tuffs zu 5 bis 10*	*C. tommasinianus*
Muscari latifolium Breitblättrige Traubenhyazinthe	*400*	*leuchtendes Blau im April/Mai, Selbstaussaat, in Tuffs zu 5 bis 10*	
Tulipa praestans 'Füsilier' *Botanische Tulpe*	*200*	*mehrblütige Tulpe, leuchtendes Orange-scharlachrot im April; einzeln oder in kleinen Gruppen*	*T. eichleri oder T. tarda oder T.orphanidea 'Whitalii'*

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Modul 8 – „Filigran“

Modul 8 **Pflanzenbedarf für 10 m² (10 Pflanzen pro m², 50 Zwiebeln pro m²)**			
Name [botanisch/deutsch]	**Empfohlener Mengenanteil** [Stück/10 m²]	**Hinweise** [W: Winterwirkung durch Strukturen und Texturen oder wintergrüne Belaubung]	**Alternativart/ -sorte**
Gerüstbildner			
Digitalis parviflora Kleinblütiger Fingerhut	8	wintergrüne Rosette, rostfarbige Blütenstände, 70 cm, sehr langlebig, ausdauernde Art trocken-steiniger Gehölzränder, bildet schöne, große Horste, schönes Wintergerüst, [W]	
Digitalis lutea Gelber Fingerhut	8	wintergrüne Rosette, hellgelbe Blüte im Frühsommer, 80-120 cm, [W]	*Digitalis grandiflora*
Begleitstauden			
Sesleria autumnalis Herbst-Kopfgras	8	frisch hellgrünes, halbwintergrünes Blaugras, sehr ausdauernd, eher langsamwüchsig, [W]	
Aster sedifolius Graublättrige Aster	5	hellvioletter Blühaspekt im Juli/ August, reichblühend	*Aster sedifolius* ‘Nanus‘, *Aster pyrenaeus* ‘Lutetia‘
Geranium Sanguineum-Hybr. ‘Khan‘ Blut-Storchschnabel	5	magentarosa Blüten, lange blühend (Mai-September)	*Geranium Sanguineum*-Hybr. ‘Tiny Monster‘
Bodendeckstauden			
Geranium x *cantabrigiense* ‘St. Ola’ Cambridge-Storchschnabel	24	Blüte weiß, rosa Kelche, großblütig, Laub färbt im Herbst gelb-orange	*Geranium* x *cantabrigiense* ‘Biokovo’
Potentilla alba Weißes Fingerkraut	18	weiße, erdbeerähnliche Blüten, verträglicher Bodendecker, 10-15 cm	
Streupflanzen			
Carex ornithopoda ’Variegata’ Vogelfuß-Segge	18	wintergrüne, heimische Segge, 10-20 cm, versamt, kurzlebig, [W]	
Anthericum liliago Astlose Graslilie	12	weiße Blüte im Frühsommer, 40-50 cm	*Anthericum ramosum*
Blumenzwiebeln und -knollen; Pflanzung im Herbst			
Eranthis cilicica Winterling	150	blüht später und ist eleganter als *E. hyemalis*, aus Zedernwäldern im Taurus	*Eranthis hyemalis*
Muscari latifolium Breitblättrige Traubenhyazinthe	150	sommergrüne Art, zweifarbige Blüte, reich versamend	
Crocus tommasinianus Elfenkrokus	200	frühe Blüte (Februar/ März)	

10.09.2018

Charakter
Ein hoher Anteil feiner Laubtexturen lässt dieses Modul sehr filigran wirken. In spannungsreichem Kontrast dazu stehen einige wenige Stauden mit größeren Laubblättern und vertikalen Blütenständen. Die Blühaspekte in hellen Farbtönen verstärken den zurückhaltenden, dezenten Charakter.

Standort und Verwendung
- sonniger, warmer Gehölzrand bis lichtschattig
- trockener bis mäßig trockener Boden
- mäßiger Wurzeldruck

Dieses Modul eignet sich sehr gut für offene, lichte Gehölzrandsituationen, z.B. auf kleinen Baumscheiben oder im Straßenbegleitgrün unter neu gepflanzten oder hoch aufgeasteten Bäumen.

Pflege
Die wintergrünen Arten benötigen keinen Rückschnitt, für das halbwintergrüne Herbst-Kopfgras (*Sesleria autumnalis*) ist ein selektiver Rückschnitt im Frühjahr empfehlenswert.

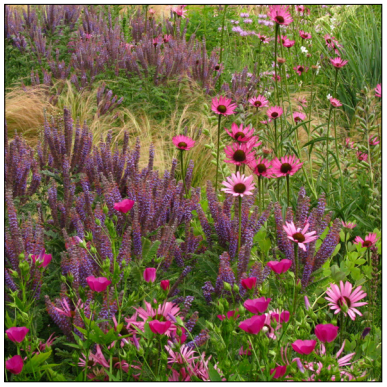
Präriemorgen

Artenliste und Charakteristik

Weinheimer Präriemischung

Standort: *trocken, durchlässig, Böden mit Kies- od. Splittanteil* **Licht:** *vollsonnig* **Farbe:** *purpurrot, rosa, weiß; Akzente: blauviolett, silbergrau*
Anwendungsgebiete: *Hausgärten, Verkehrsbegleitgrün, gewerbliches Grün; Mindestgröße der Pflanzfläche: 20 m²*
Pflege: *Rückschnitt bodeneben im Spätwinter (Jan-Feb), Schnittgut abräumen, in extremen Trockenperioden wässern*

Name *(botanisch - deutsch)*	**Stück/100m²** *(empfohlener Mengenanteil)*	**Hinweise** *(W: Winterwirkung durch Strukturen und Texturen oder wintergrüne Belaubung)*	**Alternativart/-sorte**
1. Gerüstbildner			
Amorpha canescens *Weißgrauer Bleibusch*	*25*	*kleiner Halbstrauch, Langsam-entwickler, gelbe Herbstfärbung, im Winter zierende Samenstände*	*15 Perovskia abrotanoides 'Blue Spire' oder 'Little Spire'*
Eryngium yuccifolium - Yuccablättriger Mannstreu	*20*	*Solitär, blaugraues, yuccaähnliches Laub, bizarre Gestalt*	*20 Eryngium agavifolium, 10 Yucca filamentosa*
Perovskia abrotanoides - Fiederschnittige Perovskie	*10*	*Halbstrauch, graugrünes Laub, silbriges Wintergerüst*	*Caryopteris x clandonensis, Amorpha canescens*
Schizachyrium scoparium 'Cairo' *Prärie-Bartgras*	*30*	*zierende Samenstände, rötliche Herbstfärbung, Langsamentwickler*	*Schizachyrium scoparium*
2. Begleitstauden			
Aster novae-angliae 'Purple Dome' *Raublatt-Aster*	*25*	*blauviolette Blüte, Herbstaspekt*	*20 Aster oblongifolius 'October Skies' (Aromatische Aster) oder:* *20 Aster pyrenaeus 'Lutetia'*
Gaura lindheimeri 'Elfenspiegel' *Prachtkerze*	*10*	*kompakte Sorte, weiße Blütenschleier, Blütezeit bis zum Frost, oft kurzlebig*	*Gaura lindheimeri*
Echinacea tennesseensis 'Rocky Top Hybrids' *Tennessee-Scheinsonnenhut*	*60*	*Sommeraspekt, zierende Samenstände, schön in Kombination mit Schizachyrium*	*Echinacea simulata*
Echinacea pallida *Bleicher Scheinsonnenhut*	*30*	*Frühsommeraspekt, zierende Samenstände, wenig Platzbedarf*	*Echinacea simulata*
Liatris spicata - Ährige Prachtscharte	*70*	*Sommeraspekt, zierende Samenstände, wenig Platzbedarf*	*Liatris aspera - Raue Prachtscharte*
Nassella tenuissima *Mexikanisches Fiedergras*	*50*	*feinlaubig, silbriggrün im Sommer, schöner Winteraspekt, halbwintergrün*	
Monarda fistulosa var. menthifolia *Minzblättrige Indianemessel*	*25*	*Frühsommeraspekt, kugelige Samenstände*	*Monarda fistulosa var. menthifolia in Sorten z.B. ‚Pummel' oder ‚Mohikaner'*
Pycnanthemum tenuifolium *Schmalblättrige Bergminze*	*30*	*zierende Samenstände, frischgrünes nadelartiges Laub, kurze Rhizome*	
3. Füllpflanzen (kurzlebige und ggf. einjährige Arten)			
Linum perenne - Ausdauemder Lein	*25*	*Frühsommeraspekt, kurzlebig, Selbstaussaat*	
Monarda punctata *Punktierte Indianernessel*	*15*	*zweijährig bis kurzlebig, zierende Samenstände, auffällige Hochblätter*	*Monarda citriodora*
4. Bodendecker			
Bouteloua gracilis - Moskitogras	*200*	*zierende Samenstände*	*150 Eragrostis spectabilis*
Aster ptarmicoides (Syn. Oligoneuron album) *Weiße Hochland-Aster*	*100*		*Calamintha nepeta subsp. nepeta*
Penstemon hirsutus - Haariger Bartfaden	*65*	*wintergrüne Rosetten, mäßig langlebig, Selbstaussaat*	*50 Calamintha nepeta subsp. nepeta*
Artemisia ludoviciana var. albula 'Silver Queen' *Weißer Beifuß*	*10*	*silbriges Laub, Ausläufer*	*Artemisia ludoviciana var. latiloba 'Valerie Finnis'*
5. Blumenzwiebeln und -knollen; Pflanzung im Herbst			
Allium cernuum *Nickender Lauch*	*200*	*sehr ausdauernd, bestockt gut, wintergrün*	*Allium lusitanicum (spätere Blütezeit als A. cernuum) Sorte: 'Summer Beauty'*
Anemone blanda 'White Splendour' oder 'Blue Shades' *Balkan-Windröschen*	*500*	*weiß, lange blühend, steril*	
Tulipa praestans 'Tubergen's Variety' - Botanische Tulpe	*100*	*leuchtend rot*	*Tulipa praestans ‚Füsilier'*
Narcissus triandrus 'Petrel' - Engelstränen-Narzisse	*200*	*weiß,mehrblütig, duftend*	*Narcissus cyclamineus ‚Toto'*



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Standort: *trocken bis mäßig trocken* **Licht:** *sonnig* **Farbe:** *gelb und blau*
Anwendungsgebiete: *für offene Standorte; für Hausgärten, für Stadtplätze und Flächen im ruhenden Verkehr; für Dachflächen ab 15 cm Substratdicke; für kleinere Flächen von ca. 5 bis 20 m²* **Pflege:** *Rückschnitt Mitte Februar; 3 Jätgänge pro Jahr: Ende April/Anfang Mai, Ende Juni/Anfang Juli sowie Mitte Oktober; jährlicher Zeitaufwand für die Pflege ca. 6 Minuten/m²/Jahr.*

Blütenmosaik

Artenliste und Charakteristik
Veitshöchheimer Mischung

Name *(botanisch - deutsch)*	**Stück/100m²** *(empfohlener Mengenanteil)*	**Hinweise** *(W: Winterwirkung durch Strukturen und Texturen oder wintergrüne Belaubung)*	**Alternativart/-sorte**
1. Gerüstbildner			
Aster sedifolius ‚Nanus' *Wild-Zwergaster*	*100*	*dicht beblätterte Stile, aufrecht und gedrungen wachsend, lavendelblaue Blüten [W]*	*Aster x frikartii ‚Wunder von Stäfa'*
2. Begleitstauden			
Aster linosyris - Goldhaar-Aster	*50*	*gelber Spätsommerblüher, feine Textur durch lineare Blätter*	
Campanula persicifolia *Pfirsichblättrige Glockenblume*	*60*	*hohe Stiele mit großen Blütenglocken, versamt sich gern*	*Campanula glomerata*
Festuca amethystina - Regenbogen-Schwingel	*100*	*kleine Horste mit feinen, langen Blättern*	
Linum flavum - Gelber Lein	*150*	*leuchtend gelbe Blüten, straffe Stiele, lange Blütezeit*	
3. Füllpflanzen (kurzlebige und ggf. einjährige Arten)			
Linum perenne - Blauer Stauden-Lein	*100*	*blauer Frühsommerblüher, kurzlebig, Selbstaussaat in Lücken*	
4. Bodendecker			
Geranium sanguineum ‚Lancastriense' *Blut-Storchschnabel*	*100*	*niedrige Sorte, Blüte hellrosa*	*Geranium sanguineum ‚Nanum'*
Nepeta x faassenii - Blaue Katzenminze	*80*	*graufilzig, reich und lang blau blühend*	
Sedum floriferum ‚Weihenstephaner Gold' *Reichblühendes Fettblatt*	*120*	*reich blühend, niederliegende Triebe mit spatelig-lanzettlichen Blättern*	
Thymus pulegioides - Arznei-Thymian	*150*	*langkriechende Stängel mit kleinen Blättern*	
5. Blumenzwiebeln und -knollen; Pflanzung im Herbst			
Crocus chrysanthus 'Cream Beauty' *Kleiner Krokus*	*1000*	*Blüte zart mattgelb, Selbstaussaat in Lücken, aber nicht farbtreu*	*Crocus flavus*
Muscari aucheri - Kleinasien-Traubenhyazinthe	*500*	*Blüte leuchtend himmelblau mit weißem Rand, bildet Brutzwiebeln*	*Muscari latifolium*
Tulipa tarda - Zwergstern-Tulpe	*500*	*Blüte weiß mit leuchtend gelber Basis, ausdauernd*	*Tulipa orphanidea 'Flava'*

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