

‘WEEDS’ AN EMERGING URBAN FLORA

by

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Glossary

Exotic plants:	'A exotic plant is a plant that has been introduced to an area from outside its native range, either purposefully or accidentally (FLEPPC, n.d).'
Native plants:	'Native plants are plants indigenous to a given area in geologic time. This includes plants that have developed, occur naturally, or existed for many years in an area (WIKIPEDIA, 2019a).'
Weed:	'A weed is a plant considered undesirable in a particular situation, 'a plant in the wrong place'. Examples commonly are plants unwanted in human-controlled settings, such as farm fields, gardens, lawns, and parks (WIKIPEDIA, 2019b).'
Ruderal plants:	'A ruderal species is a plant species that is first to colonize disturbed lands. The disturbance may be natural – for example, wildfires or avalanches – or a consequence of human activity, such as construction (of roads, of buildings, mining, etc.) or agriculture (abandoned fields, irrigation, etc.) (WIKIPEDIA, 2019c).'

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INTRODUCTION

The idea of this practicum came from my adviser Marcella Eaton. In her studio when we discussed the management way of organic farming, I said that then we need to get rid of weeds. But my instructor said stop...are they really 'weeds,' that we need to get rid of? And she said that dandelion is often regarded as weeds, but her mom likes to use the dandelion to make wine. And there is also a trend to use the plants that we often regard as 'weeds' to be as side dishes in some restaurants. From that moment, it opens my eyes and makes me start thinking those species in their own right instead of under their popular title 'weeds' which was often used to describe the undesirable plant by human beings.

Technically, 'weeds' refers to the species that they are in the way when people trying to conquer nature. In other words, what are 'weeds' is decided by people instead of the voice of nature. Therefore, from an ecological perspective, are these species 'bad' species? Moreover, different species can be regarded as 'weeds' by different people and time throughout history. What was once treasured species may become weeds when they go out of the fence of the garden; what was a 'weed' may be cultivated as a valuable crop. However, despite different views to these species, when a plant stands in the way of people's willingness at the moment, they would all be forcefully removed. However, sparing no effort to get rid of those species gives rise to a series of environmental issues along with a huge economic cost. All of this makes me think that we should stop thinking of these

species as 'weeds' but trying to appreciate them and to utilize them like our ancestor did in history. That's the context of this practicum. And the intention of this practicum is to change people's perception of these 'weeds'.

The first chapter examines the roles of 'weeds' throughout history, to demonstrate that as people's desire to dominate nature increased, there are more and more 'weeds' and it gave rise to many environmental issues in the process of eradicating those species, so we need to change our perception to them. The second chapter recognizes these 'nuisance' herbaceous scientifically, to illustrate that most of these 'weeds' are innocent. Instead of an environmental wrecker, they may do wonders to our ecological system. The words 'weeds' is tricky, since it can be used to describe any disliked species. However, there are indeed a certain group of species that are often regarded as 'weeds' in a specific ecoregion. Therefore, I use the City of Winnipeg as an example, and to see how 'weeds' there, could do wonders to both our life and nature. Thus, the fourth chapter is a detailed study of a group of 'weeds' that I found at the lawn in the City of Winnipeg and propose the four biggest benefits of those plants that can be utilized by the residents. To fulfill the requirements of the practicum and to apply what I found to a landscape design, I chose a forest clearing in the Assiniboine Park to design an experimental and educational garden, testing the grouping community of these 'weeds' and letting people appreciate them.

CHAPTER 1

'Weeds' in history

Prehistoric time

Figure 1.1



After the recent Ice Ages, around 10,000 years ago, Stone Age Mesopotamians in the Tigris and Euphrates basin survived by hunting and food gathering. In the early stage of the New Stone Age, most of the wild plants fed Mesopotamians are regarded as weeds today including Mallow, Dock, Dandelion etc (Mabey, 2010, p.42). There was a short transition time from food gathering to crop cultivation, with the specific reasons for this unknown.

The Fertile Crescent which stretches to the north and east of the Tigris and Euphrates, is the most important origin of cultivation (Orlando, 2018, p.11). From that location, wild grass species were selected as producing the best seeds for planting. They were the predecessors of today's staple western crops and included wheat, rye, barley, and oats (p.11). One of the most important crops must be wild emmer wheat with its rich-starched seeds (Mabey, 2010, p.43). It possesses similar genetic traits to today's crops such as growing in large clumps, and growing at the same height which might have worked to form ideas of agriculture (p.43). This may be the time when the first farmer began 'deliberate' cultivation, and when the word 'weeds' came into being as they were in opposition to the farmers desires (p.43).

From then on, the cultivation tools and methods that were invented for the preparation of ground and cultivation of crops started selecting the weedy species that can adapt to such agricultural technologies as well as the weedy species that possess the same life cycle as crops (p.45). In other words, we selected crops with its weeds at the same time. Therefore, those weedy species which are similar to the crops remained, were developed and further hybridized.

And then as early humans moved about from Fertile Crescent, the grain culture together with its weeds derived in the ancient Middle East spread slowly in the Neolithic era to reach the fringes of western Europe in the Bronze Age. There is evidence of this in pollen, as the genes of the agricultural grass species together with its grassy weeds are more closely related to the

grass species in Central Asia compared to the wild species growing in the European mountains (Orlando, 2018, p.8).

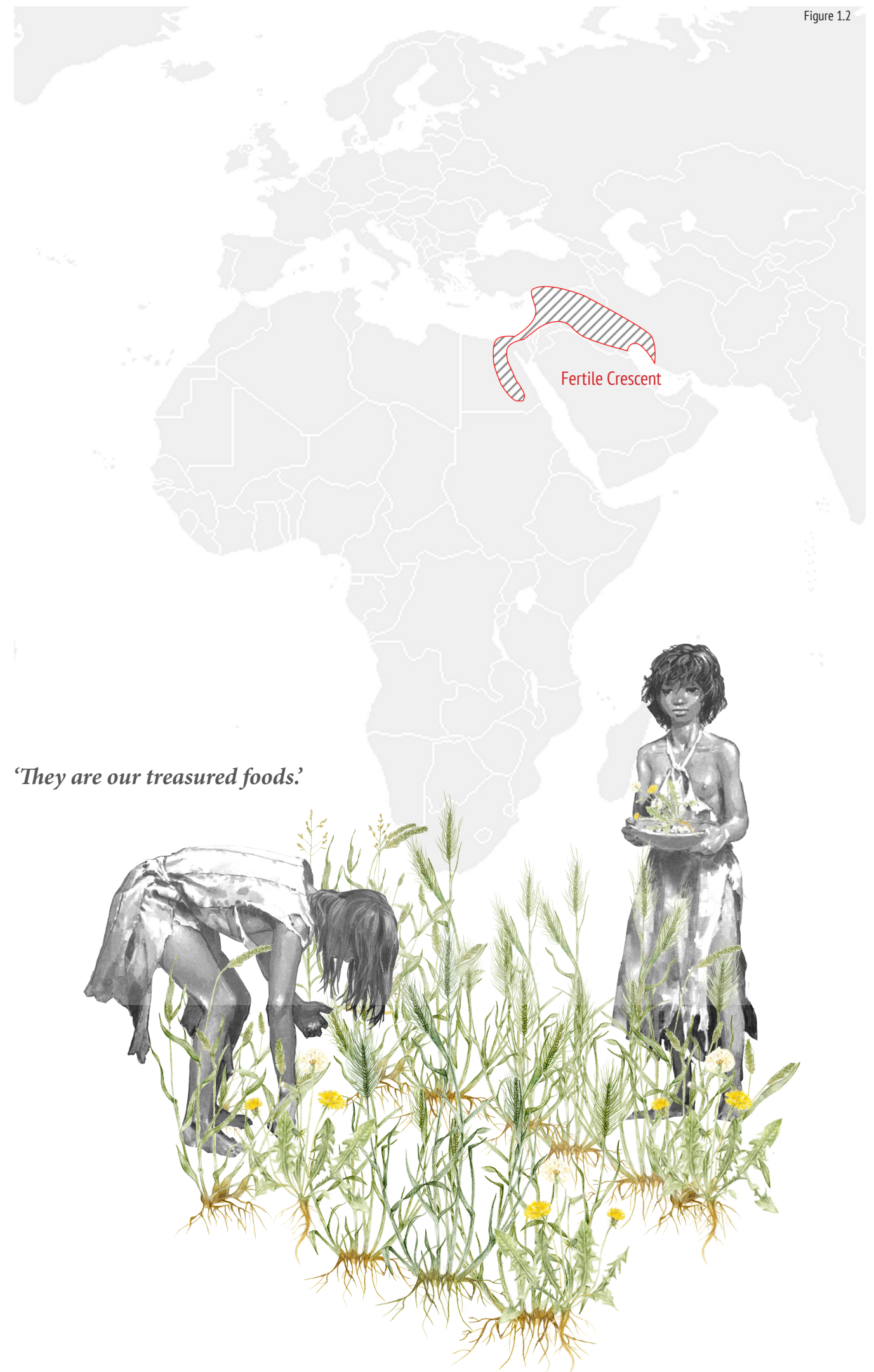
Around 2000 years before the Common Era, the movement of cereal grains together with their accompanying weeds from Near East into Europe was complete and then further extended to Asia and Africa by the implementation of grain trade from Roman Empire (Orlando, 2018, p.10; Krämer, 2016, p.135).

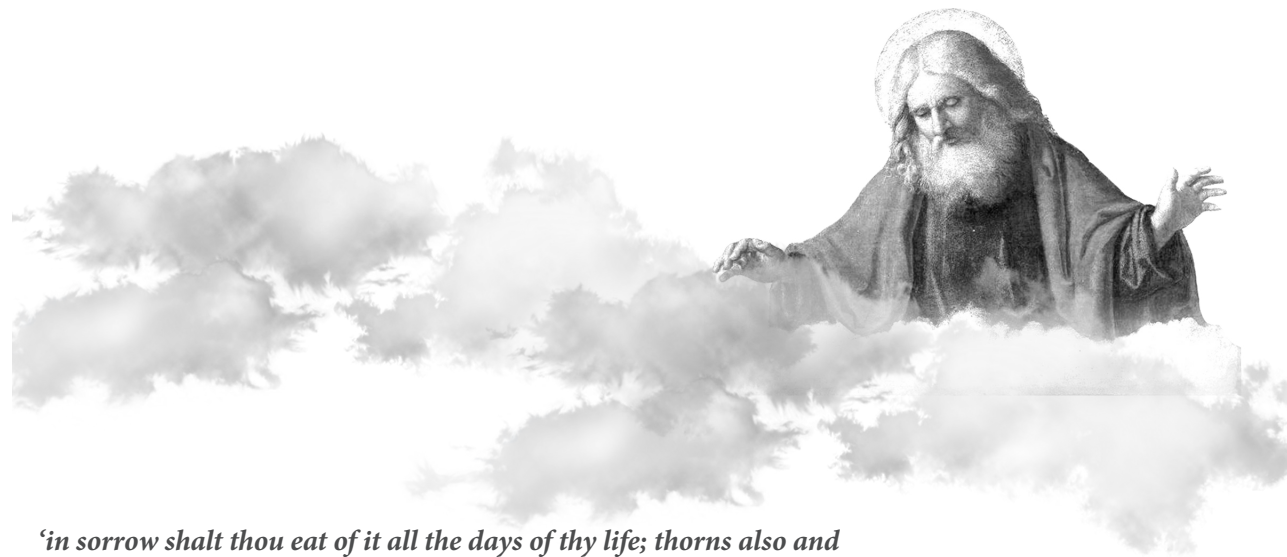
Interestingly, one explanation of why weeds grow in fields comes from the second version of Genesis, which was created before 600 BCE in Mesopotamia (Mabey, 2010, pp.39-41). In that story, after Adam ate the fruit of the tree of knowledge, which disobeyed the rules made by God, he was expelled from Eden and as the saying goes: 'in sorrow shalt thou eat of it all the days of thy life; thorns also and thistles shall it bring forth to thee; and thou shalt eat the herb of the field; In the sweat of thy face shalt thou eat bread, till thou return unto the ground.' (pp.39-41).

Unlike the fresh food that can be easily obtained in Eden, they had a hard toil to harvest food (pp.3-41). In this way, the farming activity with its by-product of weeds was interpreted as a punishment by God.

What needs to be emphasized is that even though farmers in the New Stone Age suffered from the infestation of weeds in fields, they didn't regard them as an enemy. Instead, the distinguishment between the weeds and crops was somehow blurred and interchangeable. In this way, what were crops might become weeds, and what were weeds might become crops. For example, oat which were once viewed as weeds in a cornfield in the Near East, became a crop in Europe (p.50). Moreover, when weeds were hybridized with crops accidentally due to the limitation of tools, after several generations, what was weeds 'secretly' became crops (p.45). It was not until the Middle Age when crops were highly domesticated, that a group of weeds was clarified.

Figure 1.2





*'in sorrow shalt thou eat of it all the days of thy life; thorns also and
thistles shall it bring forth to thee; and thou shalt eat the herb of the field;
In the sweat of thy face shalt thou eat bread, till thou return unto the ground.'*
(Mabey, 2010, pp.39-41)

God reverence

The herbaceous plants, most of which are perceived as weeds by us today, were widely used in the Middle Age either as medicines, dyes, or forages and ornamental plants.

The most impressive use of weeds in medieval times was as medicinal herbs. Its evidence was proved by Apuleius Platonius Herbarium created by the monks in Bury St Edmunds Abbey, where most 'weeds' mentioned were aimed to be used as medicine including Plantain, Chamomile and Trefoil (Mabey, 2010, pp.61-63). Additionally, one of the most critical herbal medicine books during that time, The English Physician in 17th century written by Nicholas Culpeper, which was a milestone towards the National Health Service includes medicinal functions of a third species which we today regarded as weeds (p.94).

Interestingly, unlike today where we scientifically investigate herbal species, weeds were then thought to be endowed with sympathetic magic power (pp.61-109). Still, weeds were regarded as Adam's curse (pp.61-109). And it was said Christian believed they were signed by God with magic power and a careful examination of their superficial appearance must be done before use (pp.61-109). As an example, the dandelion which is now recognized for their yellow flowers that function as attractors for pollinators, the yellow was then interpreted as a sign that means they could treat the urinary disorders (p.89). Also, the walnut, which is shaped like the brain, was symbolized as wisdom from God (p.89).

Moreover, the strong conviction to religious beliefs even influenced people's perception of weeds from 1500-1900 in the fields when intensive commercial farming came into being.

Generally, during this period, people began to hate weeds, as words used to describe them changed from 'ill' and 'noxious' to 'great annoyance' (Fitzherbert, et al., cited in Evans, 2002, p.38). There were three main reasons accounting for this: no effective ways were invented for weeding, despite improved agricultural techniques and tools; negative symbolic meanings were endowed for weeds, which were seen to have a stubborn character; and the increasing labour fees, which became apparent from 1700 to 1800 during the war against France (Evans, 2002, pp.39-40).

However, although farmers dislike weeds, rather than hating the weeds themselves, they were regarded as being inseparable from nature and agriculture, and as punishment of human evil and the result of poor husbandry (p.50). The appearance of weeds was interpreted as the outcome of human's idleness, which encouraged farmers to work harder (p.50).

To summarize, throughout history people's attitudes towards weeds were governed by strong religious belief. Although more people came to hate weeds, their views were generally optimistic. Weeds never became a severe problem in the Old World.



'They are the punishment of God.'



Just as Near East farmers brought their crops and weeds to western Europe, after more than two millennia, as European started to colonize North and South America, they brought their crops and animal husbandry to the New World. Numerous species were imported to be used as food, dyes, forages, ornamental plants, medicines or accidentally within the ballast or in the mix of seeds which have become 'weeds' today.

Farmers in Ontario started to learn 'good practice' from the British in the 1800s, which proved to be a failure (p.59). At the same time, an increasing number of weeds began to be a widespread nuisance for British farmers (pp.53-73). There were two major reasons. Firstly, the environmental difference caused by the transformation of land from forest to open spaces by the settlers, benefited the weeds that were preadapted to agrarian life. There was also a lack of parasites and predators for these species in the New world (pp.68-70). Secondly, forces from socioeconomic constraints included the high cost of labour due to the scarcity of workers to eradicate weeds. A market limitation forced farmers to cultivate the only cash crop - wheat, which sacrificed the soil fertility (pp.72-73).

When European settlers arrived in the prairie provinces from Ontario, they brought these weedy species (p.88). Unlike the conditions in Ontario, where the weeds were majorly formed by exotic species, the prolific native herbaceous prairie species were also considered a part of weeds as they competed with crops (pp.92-93). In this period, more open habitats with strong wind, bigger groups of weeds and environmental drawbacks together with economic constraints as farmers faced in Ontario drove the weed problem to a severe condition in the prairie provinces (pp.92-93, p.99, p.106). By 1898 Manitoba was the 'dirtiest' province (p.106). And by the time Alberta and Saskatchewan were created in 1905, their farms were largely occupied by the weeds (Alberta, Department of Agriculture cited in Evans, 2002, p.107).

However, instead of changing the farming practices to adopt to climate, and learning how to identify and control the weeds, early agricultural scientists in Canada put more focus how to eradicate weeds (pp.105-106, p.110, p.149). Children to farmers were educated to view weeds as the worst species that must be eliminated (Fletcher, et al. cited in Evans, 2002, p.85).

At the same time, from 1800s to 1900s, in the cosmopolitans of United States, weeds were regarded as an obstacle that prohibited people from distinguishing city space from the natural landscape (Falck, 2010, p.20). Thus, weeds were also regarded as a nuisance. Throughout city development, once a vacant space appeared in the city, it would soon be occupied by a bunch of weeds, and large seed banks were created in the soil (pp.22-23). The natural look of weeds in a desolate background

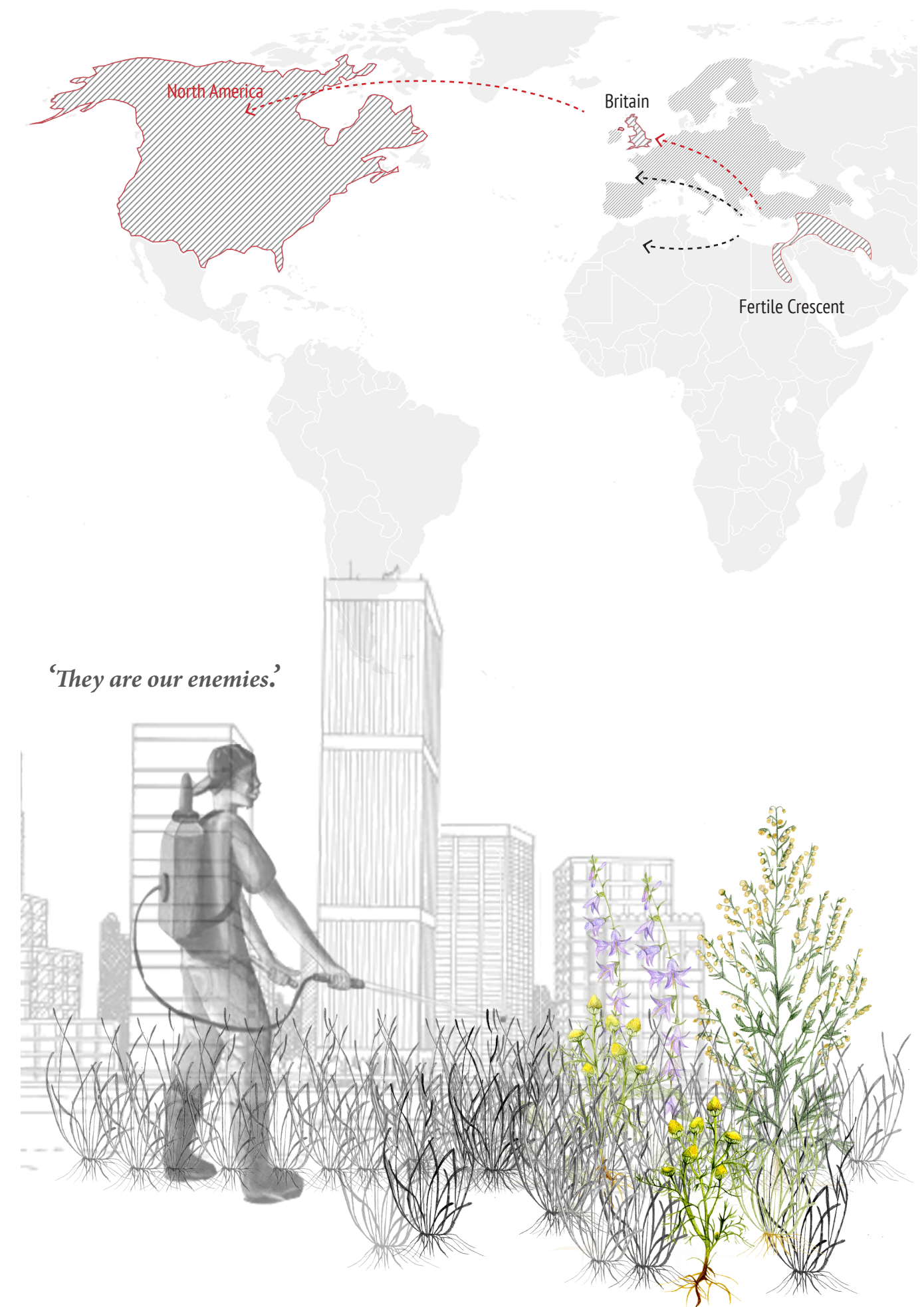
was counter to people's desire for a clean and governed city (p.28). On the otherhand, its counterpart-lawns and boulevards represented the well-organized beauty. This idea was further intensified by the City Beautiful Movement and a series of laws that presented weeds as a problem (pp.29-33, pp.37-38).

The most significant influence of designating weeds as a nuisance to the public in North America was to make people stop thinking about these wild plants by their own individual strengths but to perceive them as a collective threat to a well maintained perfect life (pp.38-40). Therefore, weeds became much less acceptable.

Eventually, feelings of disdain toward weeds by people in both agricultural fields and cities, together with the blind faith in science's ability to solve the world's problems and the vast commercial interests that can be gained by the chemical companies led to the chemical war against weeds when 2,4-D arrived in 1945. After its introduction, it was widely sprayed to the land. As it was recorded, only five years after 2,4-D was introduced in Canada, it was applied to at least 13,566,000 acres of Prairie fields (Wood, 1950 cited in Evans, 2002, p.164).

However, even with the broad usage of herbicides, weeds kept returning to the land. What resulted was the transformation of weeds flora, the development of chemical resistance ability in previously susceptible species, a big waste of energy and also a series of environmental problems. For example, the ragweed (*Ambrosia artemisiifolia* and *Ambrosia trifida*), a native plant playing as a food source for Indigenous people in history, was despised because of its pollen which causes hay fever in American cities and thereby being eliminated by using 2,4-D (Falck, 2010, pp.98-106). However, the use of herbicide never reduced allergies reports in cities, but led to its regrowth as more land was disturbed, inhibiting further natural successional process and unifying large tracts of land with the same vegetation (p.123, pp.131-132). Ironically, the reason why its pollen is so widespread compared with the pre-contact period was mainly caused by the massive disappearance of forests, which successfully created a free ground for its dispersal (p.98).

In conclusion, unlike the modest people in Old World who focused on the improvement of good practice, and perceived weeds as an inevitable part of nature, people in the New World regarded weeds as an enemy. Instead of reflecting on their culpability through the alteration of grasslands and forest to create more open habitats that benefited for exotic species growth, by planting cash crops for immediate economic rewards and their ambition to dominate nature, they unleashed a war against weeds by chemical tools, which eventually caused more environmental issues.



Conclusion

By examining history, it is evident that there are some crucial features of weeds.

First of all, weeds followed people's footprints, as it spread from Near East to Eurasia, from the Old World to the New World. And it was even intensified by traffic development, as the road became a 'natural' corridor for plants migration from one site to another. Therefore, as our world becomes global, the weeds also become the global weeds, as most areas in the world are sharing the same species, such as Clover, Plantain, Knotweeds, Thistles, Ragweed, etc.

Secondly, as human civilization, the general attitude towards weeds constantly changed in different geographic spaces and a different time. When the gathering habit collapsed, what was treasured as an essential food source at the early stage in the New Stone Age might be regarded as weeds in crop fields in the Middle Age at Eurasia, like wild rye and wild wheat. When herbal medicine was abandoned, what was treasured in medieval time in British as important medicines might be regarded as weeds in the New World, such as chamomile and clover. By this sense, we only treasure those species that can benefit us in time, and once it became useless, it is classified as weeds.

More importantly, when weeds were regarded as a severe 'issue', it resulted in more issues strengthened by economic and political forces, as our ambition grows and tries to govern nature. Ancient people at the early stage of the New Stone Age, might not have been able to separate weeds from crops, as they may have regarded all species that were edible as food. They respected and even feared nature. The sense of 'weeds' came into being as farmers started selecting 'best crops'. The noxious reputation of weeds was strengthened in Britain from 1500-1900 as commercial agriculture largely developed; the first big step was to manipulate the land. However, generally, the attitude towards weeds was much more moderate in the Old World as it was tied to the reverence of God, in comparison to people in the New World who perceived weeds as an enemy and tried to dominate nature and eradicate weeds aggressively by chemical weapons. And it turned out, we, humans can never win this battle; we can never control nature.

Therefore, why don't we stop thinking about 'weeds', but instead start to show our respect, or even to live with and to utilize them, like our ancestors did in the prehistoric times? In this way, weeds won't be 'weeds', but species with their own rights for existence, which would also relieve environmental issues that resulted from fighting with them.

CHAPTER 2

Enlightenment toward 'weeds'

Why ‘weeds’ grow

The main reason why most people hate weeds is attributed to their prolific reproduction ability. They can spread either by dispersing thousands of seeds or by vegetative reproduction from stolons, runners, rhizomes or even the fragment of roots. Moreover, most weeds can develop a consistent seed bank in the soil, since their seeds could stay dormant and even viable after dozens of years. And once the soil is disturbed, when these seeds are exposed to the air and sunshine, seedlings would germinate. Therefore, it is tough for us to control and confine their growth. That is why they are unwanted by us and entitled as ‘weeds’, because of their prolific traits.

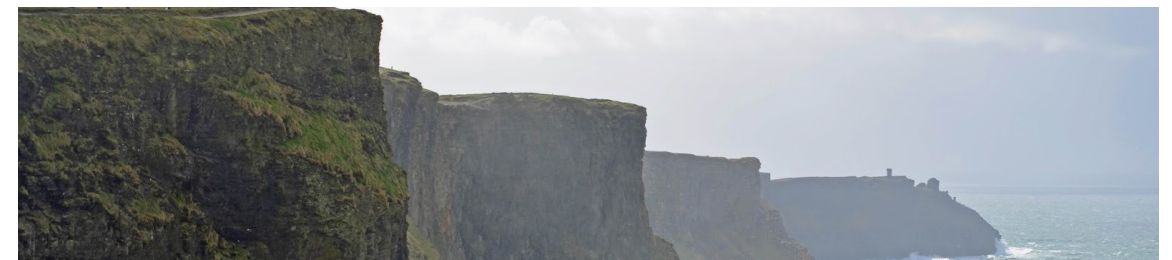
However, why do these species have such traits? Is there any reason behind?

In actuality, most of these species that we classified as weeds are ruderal species, which means that they tend to occupy bare grounds even under stressful conditions. Thus, the prolific reproduction ability is just one of their survival strategies to ensure that they are able to adapt to a harsh environment in a short time.

One of the most important theories that gives a further explanation of this trait is the ‘Urban Cliff Hypothesis’, which was tested by Lundholm and Marlin (2006). In their study, it was accepted that most species which adapts to the urban

environment originally grew in rock outcrop habitats - the extreme natural environment (Lundholm and Marlin, 2006). And the lawns, walls, pavements, compacted grounds, shallow soils as well as a series of disturbance like periodic construction, traffic movement and application of road salt in this anthropogenic age simply creates an environment that mimics the original habitats of the plants (Lundholm and Marlin, 2006). Therefore, weeds occupy the niches created for them, and without them, the soil in abandoned farmland would suffer from erosion; the ignored and polluted spaces in cities would become desolate.

However, one might argue that some species are too invasive to eradicate, as they may alter the natural areas entirely if without control. Yes, some species are indeed aggressive. However, most of the species that we called ‘weeds’ today are just a nuisance instead of being environmental wreckers. They continue to germinate as quickly as we disturb new grounds. However, once there is a closed community, they won’t enter in. That is why it is not uncommon to see that weeds patches stop at the edge of forests. Therefore, why don’t we tolerate these ‘weeds’ to some degree and even give them a space to grow?



Extreme natural environment

Figure 2.1

||



Anthropogenic environment

Figure 2.2

A well-sounded ecological weeds patch.

Introduced & Native species

Although a few native species are also regarded as weeds, introduced species are more likely to be perceived as weeds by public bias.

Today in North America, we classify those species that existed before Europeans arrived as native species (Falck, 2010, p.157). Currently, people in North America consider that 'real nature' should be formed solely by native species (pp.156-157). However, except those in reserved remnants, are there any native species in this anthropogenic environment?

When cities are built, or added on to, the first step is to remove topsoil, and then soil is brought in from other areas for construction. Therefore, the original ecological system of sites is completely altered. Peter Del Tredici, a professor at the Harvard Graduate School of Design has advocated that there is nothing native in cities, as 'native' systems have been stripped out (Cornell Botanic Gardens, 2010).

Moreover, when we judge the value of a plant, should only its origin be considered rather than its current function? As current recognition, although a group of specialized insect and animal species may only rely on true 'native' species such as the caterpillar of the monarch butterfly feeding solely on milkweed (*Asclepias spp.*), introduced species also possess essential ecological functions for more 'generalists' insect and animal species.

Besides the value for wildlife, there are also other vital functions of weeds, which are formed by both introduced and ruderal native species. Not only can they be used as dyes,

medicines, forages, foods or even ornamental plants as they did in history, they can also function as green infrastructure toward the remediation of soil, management of rainwater, regulation of noise, abatement of heat island effect and sequestration of carbon (Seiter, Farningham and Negret, 2019).

More attractively, the weeds, as a mix of introduced and native herbaceous plants may lead to a natural succession process, as it was shown through an experiment in Baltimore. Although the original purpose of this work was to study climatic influences of urbanization, the result indicated that annual weeds such as Lamb's quarter which germinated and dominated fallow farm soil in the city during the first year, eventually gave rise to more perennial herbaceous and woody plants by the end of five years (Ziska and Dukes, 2011, pp.74-75). These processes need further study because sadly these weedy patches are rarely given the opportunity to grow to determine how these ruderal species could develop through succession.

Rather than judging species from their origins or from their classification as 'weeds', they should be studied to evaluate what benefits they might offer. As the ecologist Frank Egler said, with appropriate management of common none natives that we used to call weeds, such as Dandelion, Queen Anne's lace, Lamb's quarter, Red and White clover, they could also do wonders to the landscape (Falck, 2010, p.155).



Giant weeds fiction:

Most people are afraid that as climate change, the weeds would grow crazy and threat people's survival.

'Weeds' and climate change

The emission of CO₂ in the atmosphere is largely attributed to the wide usage and exploration of fossil fuels as well as the conversion of forests to large agricultural areas (Ziska and Dukes, 2011, pp.25-29). Many have predicted that through global warming, the climate will shift dramatically.

Despite limited studies towards the relationships of climate change and weeds, it is more likely that climate change will favour the growth of weeds for several reasons (Ziska and Dukes, 2011). Firstly, the elevation of CO₂ and temperature may result in greater pollen and seed production as well as taller plants heights, contributing to a wider pollen and seed spread (pp.66-67). Secondly, because most weeds are associated with warm season crops, both the elevation of global temperature and the increasing tolerance to cold as CO₂ rises could expand the range of weeds (p.68). Thirdly, since weeds are more genetically diversified and have more fecundity in comparison to specific highly selected crops, weeds can adapt quickly to environmental change (pp.75-79).

One may argue as weeds grow much better, they may give rise to more detrimental effects such as wildfires, crop losses and more allergies as their pollen may increase both in size and quantity (p.130, p.202). There are however, still many potential benefits from weeds as the world flora shifts substantially. For example, as climate become more unpredictable, there might be more natural disasters in the future. If we are familiar with the underlying values of those stress-resistant weeds, it could be a reliable stable resource. Compared to crops, some of weeds can tolerate drought, which is due to their deep root system. If crops are susceptible to a drought year, weeds could be relied upon as a food source. Most weeds in fields possess high nutrient values and have been used by many cultures throughout history and even currently such as Kochia, Redroot pigweeds and Canada thistle. Moreover, as most cities only have a seven day supply of food, if traffic network are disrupted, weeds could provide more food options.



Conclusion

By studying weeds in a more rational and scientific perspective, we can conclude that weeds are innocent. They are simply what they are. Our interpretations place negative values toward them determining them to be good or bad. If we reconsider these judgments, and tolerate their growth, and adapt our practices in light of climate change, an appreciation of weeds could contribute to making our anthropogenic environment to be more resistant and sustainable.

CHAPTER 3

Put into practice

Study range

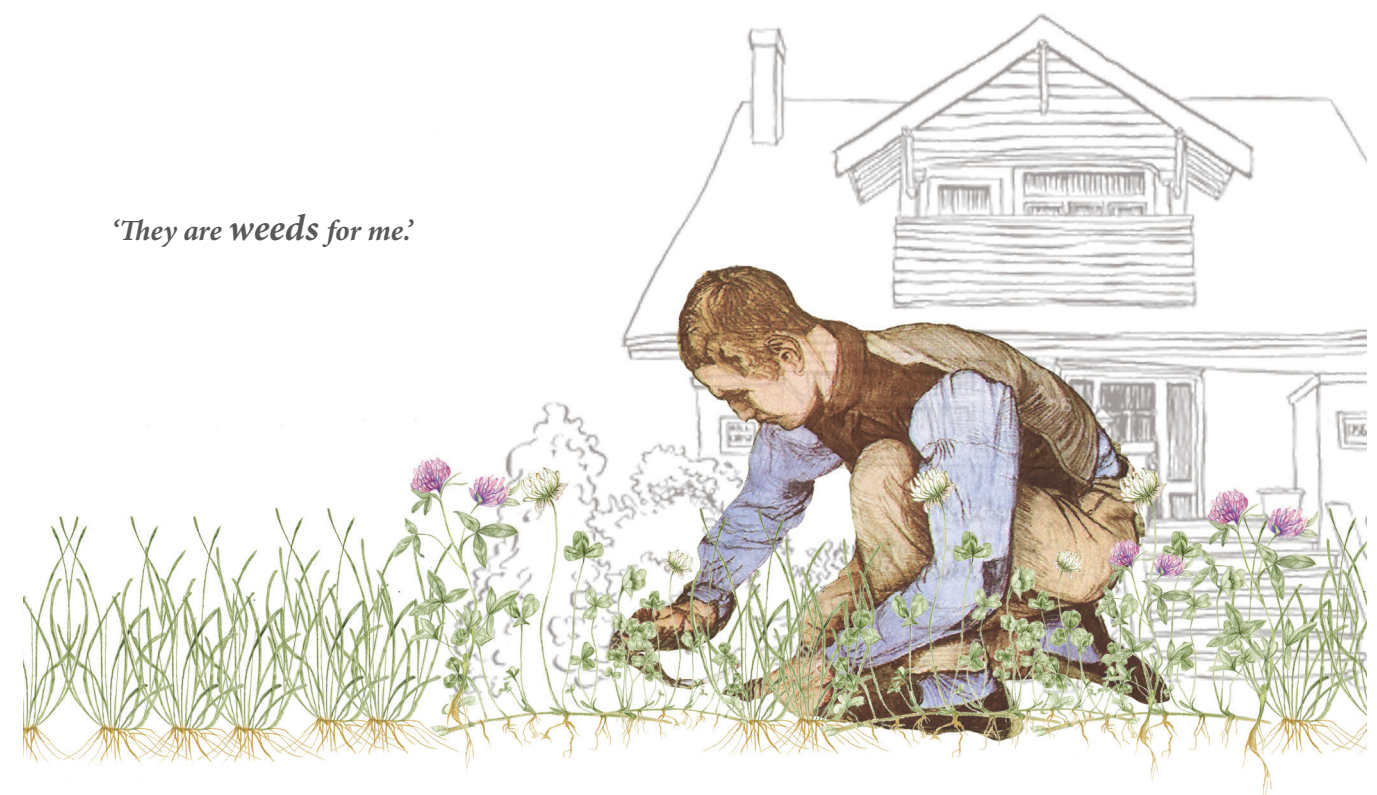
'Weeds' are defined subjectively, and it seems as long as a species is viewed with disdain by anyone, regardless of the reason, it is perceived as a weed. However, as mentioned earlier, most species are despised because of their fecundity.

Although there are globally a group of weeds which spread to virtually every continent, there are slight differences as to which species are defined as the most common due to specific geographical locations and climate variations, along with different regional parasites and pathogens.

Moreover, even in the same area, where different types of landscapes are managed for different purposes, each will define their own groups of weeds. Prolific White clover is

regarded as a weed in a highly managed turf, but due to its fecundity, it is used as a valuable forage crop in pastures. Some prolific tall grasses may be regarded as weeds in fields, but they are treasured in wild meadows.

Therefore, to focus on specific one group of weeds for this study, and to develop a local strategic design, the lawn in the City of Winnipeg was chosen as the site, because the lawn is a strictly managed field, a daily part of people's lives and the most dominant landscape type in the city.



The lawn

When Europeans came to North America, they brought their love of lawn which is primarily Kentucky bluegrass and Creeping red fescue.

Europeans were confronted with grass prairies, forests and even deserts. Regardless of the different climate and soil conditions, the settlers wanted to unify this vast landscape into a single type of landscape- the lawn (Bormann, et al., 1993, p.88). The result of this has great economic and environmental costs to maintain its monoculture of a lush green carpet.

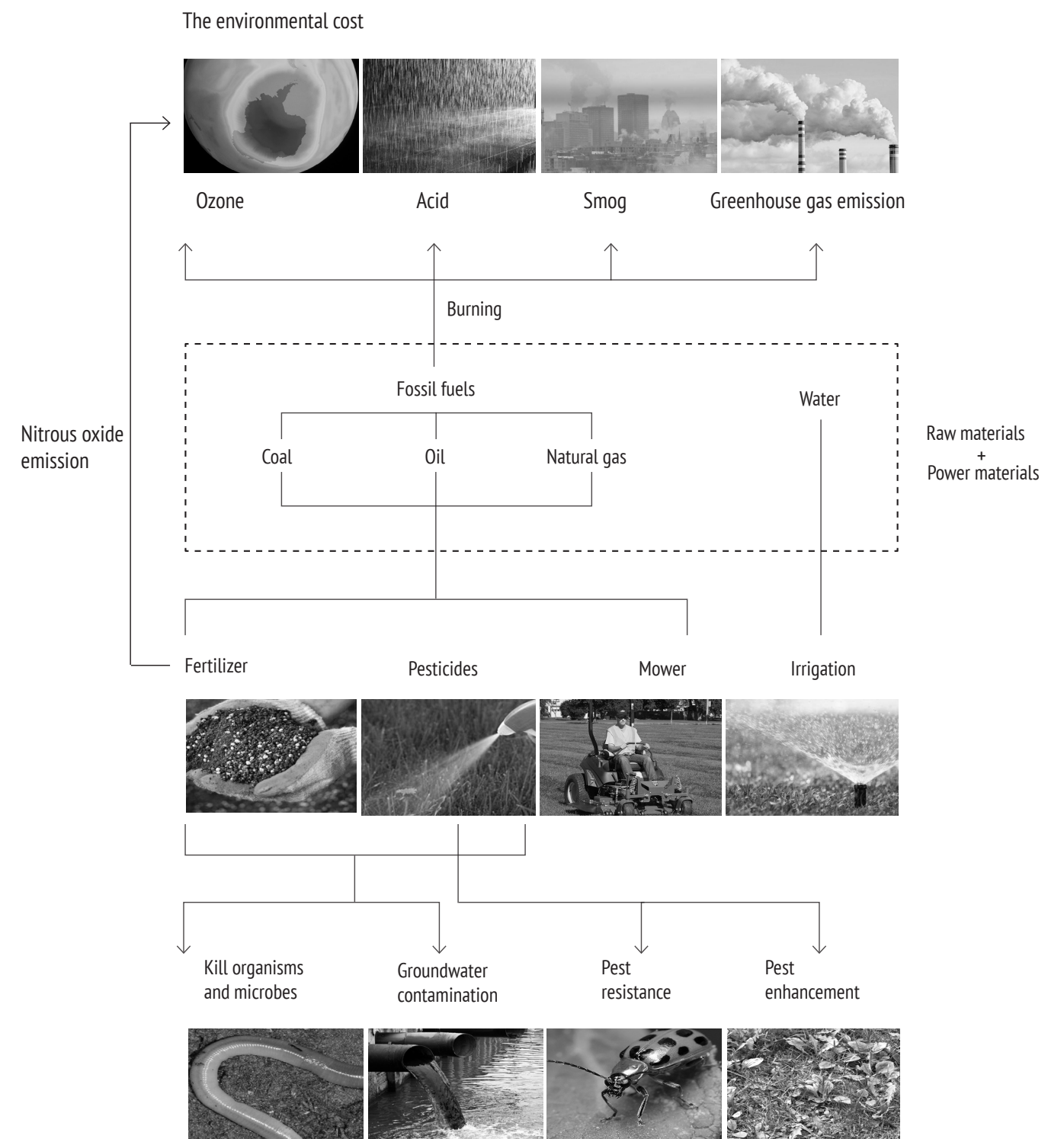
Seeds, sod, fertilizer, pesticides, oil, water, irrigation system, labours, and multiple-purpose equipment are all essential elements needed to maintain the lawn (pp.69-80). Moreover, as there are always 'advanced' technologies advocated by lawn care companies, in order to keep up with the pace of their neighbors, people tend to periodically update their lawn maintenance technologies as well (p.62). Thus, residents continually invest money and time for lawn care management. It has been estimated that lawn maintenance per acre can easily cost more money than raising crops (p.68).

Moreover, the technologies used for lawn maintenance may give rise to a series of environmental issues (see Figure 3.2). The wide usage of fertilizer, pesticides, sprayed water and mechanized machines to maintain the lawns all require fossil fuels and water to be used either as raw materials or power sources (p.89). What's more, their distribution needs transportation powered by fossil fuels (p.89), which equates to an overall large quantity of energy consumed for the care

of the lawn. Moreover, the burning of fossil fuels gives rise to the acid rain, smog, ozone and greenhouse gases emissions (p.94). Additionally, the application of fertilizers into the soil can discourage beneficial organisms and microbes and make grass species more vulnerable to disease (p.98). Excessive use of fertilizer can lead to the contamination of groundwater, and to the elimination of nitrous oxide which further damages the ozone layer (p.99, pp.109-110). The use of pesticides can also contribute to a series of environmental problems, such as pest resistance, inadvertent pest enhancement, the killing of beneficial organisms, and water and subsequent food chain pollution (p.100, p102, pp.110-111).

Therefore, all of these make the lawn more like an industrial product, rather than a well rounded ecological system. Once management is neglected, the stressful monoculture lawn is quickly occupied by a number of ruderal species- weeds.

However, though many people put a terrible name on weeds, the reason why weeds come to our lawn is to occupy the open niches as it was explained by Urban Cliff Hypothesis (Lundholm and Marlin, 2006). And as we create a similar environment as the original habitats of weeds, they could adapt well and even offer a sound ecological system.



City of Winnipeg

The City of Winnipeg is located in the Great Plain in North America and was characterized by the tallgrass prairie before contact. The Europeans cleared trees, eradicated grasses, tilled the ground and killed keystone species. They virtually converted the existing ecological system into an industrial landscape of massive agricultural fields.

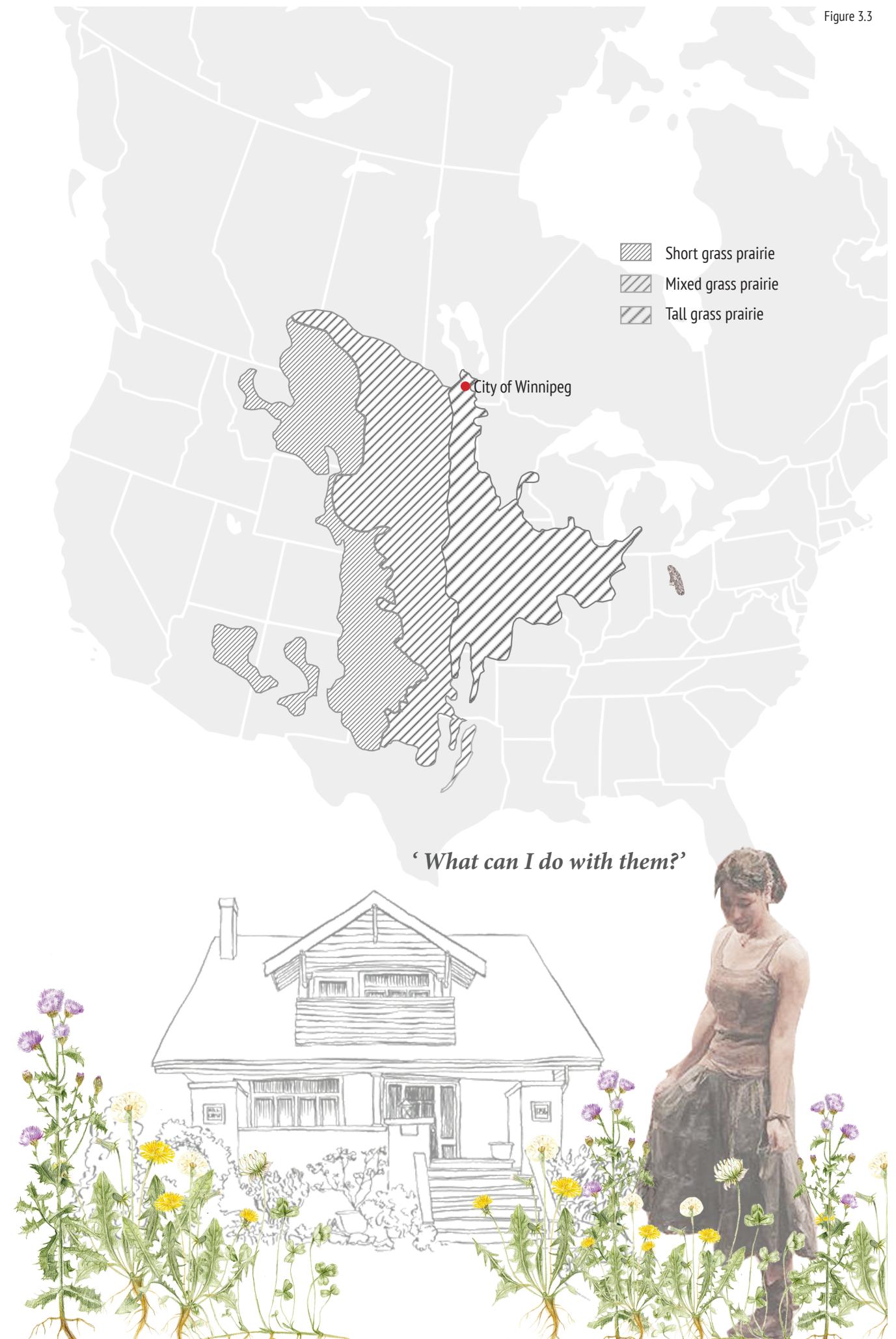
At the end of the nineteenth century, exotic species that were introduced from Europe and some prolific native tall grasses were regarded as weeds in fields (Evans, 2002, pp.92-93). Weed infestation appeared so severe in the prairie climate that the first Noxious Weeds Act was approved in 1871 by the Government of Manitoba, forcing farmers to eradicate these 'weeds'. The Act underwent numerous versions throughout the years by continuously adding new species as weeds until more than 500 plants were included. This did not make any sense as many species were simply a nuisance, rather than causing any severe economic and environmental drawbacks (Dawson, 2015). The more recent 2015 Noxious Weeds Amendment Act has been modified to only 89 plants and they are classified as tier 1, 2 and 3 by their spread and invasive levels. The 2015 Act is a province wide legislation (except for the species *Odontites vernus*).

Synthetic herbicides were banned in 2015 in the City as a concern for public health, regulated by the Non-Essential Pesticide Use Regulation under The Environment Act. The

major herbicides that are widely used today are *Weed B Gon* and *Fiesta*, both of which are iron-based herbicides and advocated as 'eco-green'. However, while *Weed B Gon* is not that effective, *Fiesta* is too expensive to use. City residents are currently frustrated by the Neighbourhood Livability Bylaw which mandates grass to be under six inches. This has become a conventional measure as a general acceptance of lawn, but specific reasons for this height are not given.

During my field study, residents in the Waverley Heights neighborhood reported that some neighbors still use 2,4-D secretly as it is a banned synthetic herbicide. In a survey of approximately 30 lawn care companies in Winnipeg, though asked what are the most prevalent weeds in the city, they did not offer a full list. They cited Chickweeds, Canada thistle, Creeping charlie, Broadleaved plantain, Dandelion, White and Red clover, only seven species of the 47 which are dominant in city lawns. Unfortunately, as they fail to identify all of these species, they are likely treating all of them as one homogeneous group by using *Fiesta*. Ironically, some of these lawn care companies have even been operated for more than 30 years in the city.

Figure 3.3



Conclusion

As there is a significant cost - both economic and environmental, toward the maintenance of lawn, weeds could be left to grow and remediate the degraded turf. More knowledge and study of weeds in Winnipeg is required to overcome the intolerance of these plants known as weeds by both residents and professionals.

CHAPTER 4

Benefits of ‘weeds’

4.1. 47 ‘Weeds’ in Winnipeg

This chapter gives a detailed description about the information of 47 ‘weeds’ that are found in the lawns in the City of Winnipeg. It records basic information including the growth year, family, height, origin and spread of these ‘weeds’. It also explains the damage these ‘weeds’ may cause. Along with emphasizing the benefits of these plants, the threats must also be reviewed as the damage can be serious including damage to crops, reduction of milk produced by livestock, allergens to people, etc. The multiplication of these ‘weeds’ is also included, as was stated earlier, the reasons they are classified as weeds is primarily due to their prolific reproductive qualities. It is imperative to understand this. Current management illustrates accepted management technique to control the spread of ‘weeds’. The competition with other species is a very important aspect of understanding the level of ‘nuisance’ that the plant will have, rather than it causing environmental damage. Many ‘weeds’ are outcompeted by other species. Shade tolerance and soil type are recorded to illustrate the optimal habitat for the ‘weeds’. The community associated with each species is also included. A general idea of which species possibly work well together, regardless of current communities of plants is included. This section gives a brief introduction to the function of these plants, which will be further explored in Section 4.2

Legend of functions:



Edible value



Medicinal value



Pollinator support



Soil remediation



Wildlife support



Ornamental value



Fodder value



Songbirds support

Yarrow *Achillea millifolium*

Growth year: Perennial (Warwick and Black, 1982)

Family: Asteraceae (Warwick and Black, 1982)

Height: 30-60 cm (Hilty, n.d.)

Origin and spread: Yarrow is a native species in North America (Del Tredici, 2010)

Damage: Yarrow may taint the flavor of milk if ingested by cattle in pastures (Warwick and Black, 1982). It also contains the allergen, sesquiterpene lactones which may cause rashes to some individuals (Warwick and Black, 1982).

Reproduction: The plant is self-sterile and completely relies on insects for cross-pollination (Warwick and Black, 1982).

It can reproduce by both rhizomes and seeds (Warwick and Black, 1982). The mean number of seeds produced is 1,920 per plant (Warwick and Black, 1982).

Yarrow has a rhizomatous root system, but its reproduction ability is less vigorous compared to other perennial weeds (Warwick and Black, 1982). Its deep root system enables the plant to survive in long dry spells (Warwick and Black, 1982).

Current management: Mowing will not eliminate yarrow in lawn. (Gift, 2011, p.76)

Competitive ability: Even its vegetative reproduction ability can be a competitive advantage in a closed community, it's still not that competitive in a well-established community (Warwick and Black, 1982). Yarrow also has self-thinning effect (Warwick and Black, 1982). With increasing density, it more relies on vegetative reproduction ability, whereas the seeds are less produced (Warwick and Black, 1982).

Shade tolerance: It grows well in full and partial sun, but it also adapts to shaded areas (Hilty, n.d.; Warwick and Black, 1982).

Soil type: While it grows well in moist to dry conditions, clay-loam soils, it also tolerates infertile dry sandy and saline soils (Hilty, n.d.; Warwick and Black, 1982).

Functions:

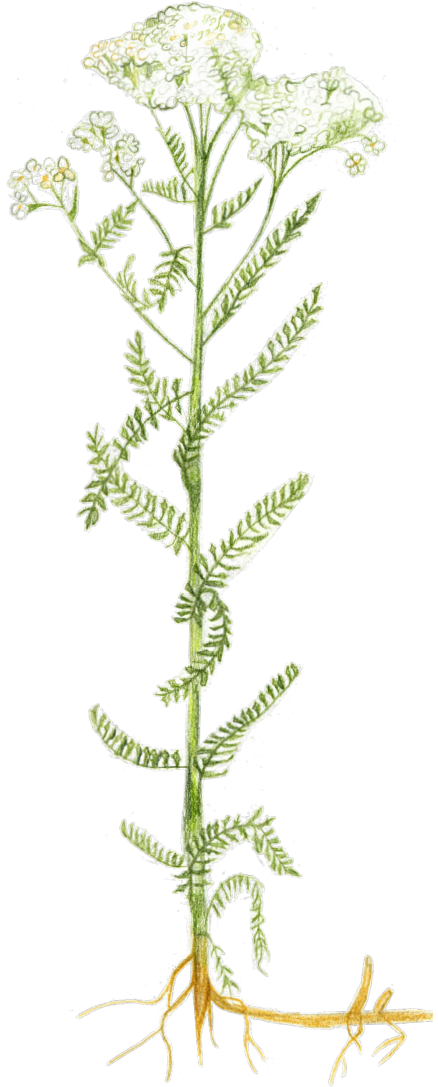


Figure 4.1.1

Quackgrass

Elymus repens

Growth year: Perennial (Werner, Patricia and Rioux, 1977)

Family: Poaceae (Werner, Patricia and Rioux, 1977)

Height: 30-120 cm (Werner, Patricia and Rioux, 1977)

Origin and spread: Quackgrass, which was introduced to North America from Europe, is likely due to seed contaminant (Werner, Patricia and Rioux, 1977). It was found throughout Canada but more prevalent in the southeast (Werner, Patricia and Rioux, 1977).

Damage: Quackgrass is a serious weed in almost all provinces of Canada, except the three prairie provinces where the climate is much drier (Werner, Patricia and Rioux, 1977). Its strong competitive ability is predominantly due to its aggressive vegetative reproduction, excessive extraction of minerals and possibly the allelochemical toxins it contains (Werner, Patricia and Rioux, 1977). Its seeds are also likely to be a contaminant in forage crops (Manitoba Agriculture, n.d.).

Reproduction: Quackgrass is self-incompatible and mainly relies on wind for cross-pollination (Werner, Patricia and Rioux, 1977).

It mainly relies on vegetative reproduction by spreading rhizomes, but it can still reproduce from seeds (Werner, Patricia and Rioux, 1977).

There are approximately 25-40 seeds produced per stem (Werner, Patricia and Rioux, 1977). Since there is no specialized vector for seed dispersal, seeds are more likely to fall beside the parent plant (Werner, Patricia and Rioux, 1977). The viability of seeds is up to four years, if buried in soil (Werner, Patricia and Rioux, 1977).

Quackgrass has a strong rhizome root system for reproduction which can also release a toxic chemical to inhibit the growth of its neighboring plants. (Manitoba Agriculture, n.d.)

Current management: The control of this species involves the cutting, tilling and exhausting of underground rhizomes, followed by deep burial (Werner, Patricia and Rioux, 1977).

Competitive ability: Quackgrass is a ruderal species, which frequently occupies open and disturbed habitats (Werner, Patricia and Rioux, 1977). It can be outcompeted by herbaceous dicotyledonous species (broadleaved weeds) in following successional years (Werner, Patricia and Rioux, 1977). It is not that competitive in a closed community and won't survive under the shrub and forest cover (Werner, Patricia and Rioux, 1977).

Shade tolerance: It prefers sunny areas to grow (Hilty, n.d.).

Soil type: It grows well in moist to slightly dry conditions, neutral to alkaline soils with numerous types of soil textures including loam, clay-loam, gravel and sand. (Hilty, n.d.; Werner, Patricia and Rioux, 1977) It also tolerates compacted ground, saline soils and the soil with a PH from 4.5 to 8.0 (Werner, Patricia and Rioux, 1977).

Functions:      



Figure 4.1.2

Redroot pigweed

Amaranthus retroflexus

Growth year: Annual (Costea, Weaver and Tardif, 2004)

Family: Amaranthaceae (Costea, Weaver and Tardif, 2004)

Height: 30-90 cm (Hilty, n.d.)

Origin and spread: Redroot pigweed was introduced to Canada from the southern part of North America (Costea, Weaver and Tardif, 2004).

Damage: Redroot pigweed is a common weed for many crops (Costea, Weaver and Tardif, 2004). It is able to inhibit and damage the growth of crops by allelopathic effects or by playing as a host for pest and pathogens (Costea, Weaver and Tardif, 2004). Moreover, it is resistant to many herbicides, which makes it difficult to be eliminated from fields (Costea, Weaver and Tardif, 2004). It can also be poisonous to livestock if its stems and leaves are eaten in large amounts (Costea, Weaver and Tardif, 2004). Also, some people may be allergic to its wind-dispersed pollen (Costea, Weaver and Tardif, 2004).

Reproduction: Flowers are imperfect (Costea, Weaver and Tardif, 2004). Normally, the male flower would dominate the top of a cyme, while the female flower would occupy its lower part (Costea, Weaver and Tardif, 2004). A single species of Redroot pigweed is self-compatible and mainly self-pollinated with the help of wind or gravity (Costea, Weaver and Tardif, 2004). This is scant evidence of cross-pollination (Costea, Weaver and Tardif, 2004).

It reproduces only by seeds (Costea, Weaver and Tardif, 2004). Redroot pigweed can produce up to 100,000 seeds per plant (Costea, Weaver and Tardif, 2004). The seeds can be spread by water and animals (Costea, Weaver and Tardif, 2004). As it is rarely dispersed by wind, it is more likely to fall beside the parent plant (Costea, Weaver and Tardif, 2004). However, if the seeds are left on stems during the winter, it is much easier to be spread by wind through frozen grounds (Costea, Weaver and Tardif, 2004). A single lost seed in a cyme may stimulate it to redevelop next to a pair of ovaries, which may eventually give rise to two new seeds (Costea, Weaver and Tardif, 2004). The viability of its seeds is up to five years, so it is able to form a persistent seed bank (Manitoba Agriculture, n.d.).

Current management: Cultivation, rotary hoeing, mowing, flaming, covering by mulches or cover crops are all effective ways to control the growth of its small seedlings (Costea, Weaver and Tardif, 2004). Moreover, the plant is also easily eliminated by hand, pulling it in any stage of its life (Roth, 2002).

Competitive ability: Redroot pigweed is a ruderal species that tends to occupy the disturbed habitats (Costea, Weaver and Tardif, 2004). It won't survive in shaded and closed communities (Costea, Weaver and Tardif, 2004).

Shade tolerance: It thrives in full sun and doesn't tolerate shade (Hilty, n.d.).

Soil type: It grows well in mesic to dry conditions, loam, clay-loam and gravel soils (Hilty, n.d.), and it adapts to both fertile and poor soil with a variety of PH levels, though it grows much better in rich moist soil (Costea, Weaver and Tardif, 2004).

Community: It would compete for resources with *Medicago sativa* (Costea, Weaver and Tardif, 2004). *Chenopodium album*, *Echinochloa crusgalli*, and *Setaria viridis* are all species found associated with Redroot pigweed in Canada, while *Ambrosia psilostachya*, *Rumex crispus*, *Cirsium arvense* dissuades the emergence and growth of this species (Costea, Weaver and Tardif, 2004).

Functions:      



Figure 4.1.3

Perennial ragweed

Ambrosia psilostachya

Growth year: Perennial (Bassett and Crompton, 1975)

Family: Asteraceae (Bassett and Crompton, 1975)

Height: 30-60 cm (Hilty, n.d)

Origin and spread: Perennial ragweed is a native in North America (Bassett and Crompton, 1975). It is widely distributed throughout Canada except Newfoundland (Bassett and Crompton, 1975). It is quite abundant in prairie provinces (Bassett and Crompton, 1975).

Damage: The most severe damage this plant affords is hay fever during the summer from its pollen (Bassett and Crompton, 1975).

Reproduction: Perennial ragweed is primarily cross-pollinated by wind (Bassett and Crompton, 1975). Female and male flowers are separate on different parts of the plant (Bassett and Crompton, 1975).

While it can reproduce from seeds, it mainly relies on rhizomes (Bassett and Crompton, 1975). The number of seeds it produces is small (Bassett and Crompton, 1975).

It has many lateral roots that can give rise to a new plant (Bassett and Crompton, 1975). Its root system can also survive the winter (Bassett and Crompton, 1975).

Current management: For management, cutting is needed before the flowering stage. If this practice is conducted for years, the root system can be successfully exhausted (Bassett and Crompton, 1975). However, clipping the main stems will result in more shoots at the end (Bassett and Crompton, 1975).

Competitive ability: Perennial ragweed is often found in disturbed habitats, but it can also invade the open grassy sward (Bassett and Crompton, 1975).

Shade tolerance: It thrives in full sun and is susceptible in shade. (Hilty, n.d)

Soil type: It tolerates alkaline soils but prefers sand, gravel and well-drained soils though it can adapt well in moist and rich soil if there is little competition from other plants. (Bassett and Crompton, 1975; Hilty, n.d)

Functions: 



Figure 4.1.4

Common burdock

Arctium minus

Growth year: Biennial (Gross, Werner and Hawthorn, 1980)

Family: Asteraceae (Gross, Werner and Hawthorn, 1980)

Height: 50-150 cm (Gross, Werner and Hawthorn, 1980)

Origin and spread: Common burdock was introduced to North America from northern Europe (Gross, Werner and Hawthorn, 1980).

Damage: Common burdock can reduce the value of wool once if its seeds attach to the coats of sheep (Gross, Werner and Hawthorn, 1980). It may also taint milk if ingested in a large quantity by livestock (Gross, Werner and Hawthorn, 1980). The pathogens hosted on Common burdock can cause damage to several crops (Gross, Werner and Hawthorn, 1980). The bristles on its capitula may also cause allergies to some individuals (Gross, Werner and Hawthorn, 1980).

Reproduction: Even though Common burdock is self-compatible and can be self-pollinated, cross-pollination is more prevalent (Gross, Werner and Hawthorn, 1980).

It is reproduced only by seeds, producing up to 18,000 seeds per plant (Gross, Werner and Hawthorn, 1980). The hooks on outer phyllaries enable the seeds attached to the fur of animals or humans for dispersal (Gross, Werner and Hawthorn, 1980). The seeds can also be dispersed to a long distance by water or by wind on frozen ground during winter, even though it is more likely to fall beside parent plant (Gross, Werner and Hawthorn, 1980). The invention of Velcro was inspired by its hooks (Del Tredici, 1945). The viability of seeds is up to three years (Gross, Werner and Hawthorn, 1980).

It has a long taproot with a rosette that can overwinter (Gross, Werner and Hawthorn, 1980).

Competitive ability: It is a ruderal species (Gross, Werner and Hawthorn, 1980). The big leaves developed from a rosette that blocks light penetration thereby inhibiting the emergence of seedlings for other species and forming open spaces for its own colonization (Gross, Werner and Hawthorn, 1980). The high density of seedlings can form under the bare patches of its leaves (Gross, Werner and Hawthorn, 1980).

Shade tolerance: It adapts well to full sun and partial sun (Hilty, n.d.).

Soil type: Though Common burdock prefers a moist to mesic level in fertile loamy soils, it can also be found in drier and other types of soils (Hilty, n.d.; Manitoba Agriculture, n.d.)

Community: Common burdock is commonly associated with *Elymus repens*, *Cirsium arvense*, *Taraxacum officinale* and *Achillea millifolium*, and less commonly with *Rumex crispus* and *Trifolium pratense* as found in an abandoned field in Michigan (Gross, Werner and Hawthorn, 1980).

Functions:   



Figure 4.1.5

Silverweeds

Argentina anserina

Growth year: Perennial

Family: Rosaceae

Height: 5-20 cm

Origin and spread: Silverweeds is native in North America (Miyanishi, Eriksson and Wein, 1991).

Damage: It is considered a weed in highly managed areas, such as lawns and gardens .

Reproduction: Silverweeds is self-incompatible, and mainly relies on cross-pollinated by insects (Miyanishi, Eriksson and Wein, 1991). Flowers can either be developed from the parent ramets or from the internodes on stolon, which means the seed production and vegetative reproduction are linked together (Miyanishi, Eriksson and Wein, 1991).

While it depends on seeds production to explore new habitats, it mainly relies on vegetative reproduction in natural environment (Miyanishi, Eriksson and Wein, 1991).

Seeds are more likely to fall beside parent plant, while they can also move a long distance, in as example floating in a water (Miyanishi, Eriksson and Wein, 1991). It doesn't have a persistent seed bank (Miyanishi, Eriksson and Wein, 1991).

There are normally two bracts on a stolon (Miyanishi, Eriksson and Wein, 1991). One is able to root, thereby giving rise to a daughter ramet, while the other forms a further stolon internode (Miyanishi, Eriksson and Wein, 1991). When the internode withers in the fall, the daughter ramet becomes independent, resulting in a new plant (Miyanishi, Eriksson and Wein, 1991). A ramet has a vertical rhizome with many creeping branches (Miyanishi, Eriksson and Wein, 1991). The vegetative reproduction ability of this species is quite vigorous (Miyanishi, Eriksson and Wein, 1991). A single mother ramet may give rise up to 10 stolons and 50 daughter ramets (Miyanishi, Eriksson and Wein, 1991). Silverweeds overwinter as short vertical rhizomes (Miyanishi, Eriksson and Wein, 1991).

Competitive ability: Silverweeds adapt well in disturbed and open habitats (Miyanishi, Eriksson and Wein, 1991). However, when they compete with other species, its reproduction ability highly decreases (Miyanishi, Eriksson and Wein, 1991). It may also be outcompeted by tall grasses, due to its intolerance of shade (Miyanishi, Eriksson and Wein, 1991). It also has a self-thinning effect, as its density is internally governed (Miyanishi, Eriksson and Wein, 1991).

Shade tolerance: It thrives in full sun and can be quite susceptible to shade (Hilty, n.d.; Miyanishi, Eriksson and Wein, 1991).

Soil type: It adapts well to mesic and wet condition, gravelly and sandy, calcareous, alkaline or saline soils (Hilty, n.d.; Miyanishi, Eriksson and Wein, 1991).

Community: *Hordeum jubatum* and *Potentilla argentea* are found associated with Silverweed in mesic soil (Miyanishi, Eriksson and Wein, 1991).

Functions:     



Figure 4.1.6

Absinthe

Artemisia absinthium

Growth year: Perennial (Maw, Thomas and Stahevitch, 1985)

Family: Asteraceae (Hilty, n.d.)

Height: 40-150 cm

Origin and spread: Absinthe was intentionally introduced from Europe to North America for its medicinal and flavoring value (Maw, Thomas and Stahevitch, 1985). It has spread across North America but it is more prevalent in western Canada and the northern Great Plain states (Maw, Thomas and Stahevitch, 1985).

Damage: Absinthe may accidentally become very dense in fields, though it's more likely to stop at edges (Maw, Thomas and Stahevitch, 1985). When cattle occasionally graze it in pastures, it can taint the flavor of milk (Maw, Thomas and Stahevitch, 1985). Its odour may cause illness to some people, and its pollen may make sensitized people great discomfort (Maw, Thomas and Stahevitch, 1985).

Reproduction: The flower of Absinthe is cross-pollinated by wind which can carry pollen long distances (Maw, Thomas and Stahevitch, 1985). Insects are attracted to it for feeding pollen and shelter (Maw, Thomas and Stahevitch, 1985).

This species is only reproduced from seeds (Maw, Thomas and Stahevitch, 1985). The mean number of seeds produced is 11,530 in the West (Maw, Thomas and Stahevitch, 1985). Though the seeds are more likely to fall around the parent plant, they can travel long distances by wind as parts of the plant can break off, or when its seeds float in water (Maw, Thomas and Stahevitch, 1985). There is no record of its seeds being dispersed by animals (Maw, Thomas and Stahevitch, 1985). The viability of seeds is 3-4 years (Maw, Thomas and Stahevitch, 1985).

It has a fibrous root system and it overwinters as seeds or as rosettes (Maw, Thomas and Stahevitch, 1985).

Current management: The cultivation of soil at late summer and fall can prevent the germination of seedlings (Maw, Thomas and Stahevitch, 1985). Mowing can reduce seed production but will not stop it (Maw, Thomas and Stahevitch, 1985).

Competitive ability: The plant relies on seed dispersal when colonizing open spaces (Maw, Thomas and Stahevitch, 1985). It is not a competitive plant in a closed sward and tends to only occupy bare and disturbed areas (Maw, Thomas and Stahevitch, 1985). It has a self-thinning effect to regulate its own population (Maw, Thomas and Stahevitch, 1985). Intraspecific competition influences the morphology of this plant (Maw, Thomas and Stahevitch, 1985). While much shorter and thinner when in high density, it is much taller and branched when it is in a lower density (Maw, Thomas and Stahevitch, 1985).

Shade tolerance: It thrives in full sun or partial sun (Hilty, n.d.).

Soil type: It prefers moist to dry-mesic environments, and grows well in loam, clay-loam and gravel soils (Hilty, n.d.). It doesn't tolerate saline soil (Maw, Thomas and Stahevitch, 1985). When there is enough moisture, the color of the plant is green, while in drier soils, it turns a grey-green tone (Maw, Thomas and Stahevitch, 1985).

Functions: 



Figure 4.1.7

Biennial wormwood

Artemisia biennis Willd

Growth year: Annual or biennial (Kegode and Darbyshire, 2013)

Family: Asteraceae (Kegode and Darbyshire, 2013)

Height: 100-300 cm (Kegode and Darbyshire, 2013)

Origin and spread: Biennial wormwood is a native in the northwestern United States and western Canada. (Kegode and Darbyshire, 2013)

Damage: Biennial wormwood is an essential weed in the prairie provinces for several crops, because of its seeds fecundity, allelopathic effects and herbicides resistance (Kegode and Darbyshire, 2013). Milk can also be tainted if cows even occasionally eat it in pastures (Kegode and Darbyshire, 2013). Its pollen may cause hay fever to some people (Kegode and Darbyshire, 2013).

Reproduction: The flower of Biennial wormwood is anemophily, although sometimes its pollen is transferred by pollen-eating insects (Kegode and Darbyshire, 2013). The species has both annual and biennial variants (Kegode and Darbyshire, 2013). The transition from annual to biennial is determined by specific conditions (Kegode and Darbyshire, 2013). The species with an annual life-cycle rely on cross-pollination due to its self-incompatibility, while cross-pollination and self-pollination are all possible for the biennial variety (Kegode and Darbyshire, 2013).

The range of seeds production is from 400,000 to 1 million (Kegode and Darbyshire, 2013). The light weight of the seeds make them easy to be dispersed by water and wind (Kegode and Darbyshire, 2013).

It can produce a large taproot to overwinter and give birth to the new plant in the following year (Kegode and Darbyshire, 2013).

Current management: Frequent mowing and pulling before flowering can be an effective way for its control (Kegode and Darbyshire, 2013).

Competitive ability: Biennial wormwood prefers disturbed sites (Kegode and Darbyshire, 2013). It may become competitive when it becomes dense in disturbed areas due to its allelopathy and prolific seed production (Kegode and Darbyshire, 2013). The allelopathy effect of this plant gives it a competitive edge as it can inhibit the growth of other species. This impact increases as the plant grows (Kegode and Darbyshire, 2013).

Shade tolerance: Biennial wormwood prefers full sun to grow (Kegode and Darbyshire, 2013).

Soil type: Biennial wormwood grows well in moist to dry condition, clay, clay-loam and gravel soils. It may die in dry condition but it can tolerate extreme moist soil, including those prone to moderate flooding (Kegode and Darbyshire, 2013). However, high moisture can also deplete the seed bank (Kegode and Darbyshire, 2013).

Functions:  



Figure 4.1.8

Creeping bellflower

Campanula rapunculoides

Growth year: Perennial (Hilty, n.d.).

Family: Campanulaceae (Hilty, n.d.).

Height: 45-90 cm (Hilty, n.d.).

Origin and spread: Creeping bellflower was introduced from Europe to North America for its ornamental value (Alberta invasive species council, 2014).

Damage: Creeping bellflower is regarded as a weed in highly managed areas, such as garden and turf (Kaulbars, 2000). Its resistant to many herbicide make it hard to remove (Alberta invasive species council, 2014).

Reproduction: The plant is primarily cross-pollinated by insects, but it can occasionally self-pollinated (Alberta invasive species council, 2014).

It is reproduced by both seeds and rhizomes, producing more than 3,000 seeds per plant (Kaulbars, 2000). It has wings attached to its seeds which can help their dispersal (Alberta invasive species council, 2014).

The underground rhizomes can give rise to a new plant, including even a fragment of a root left in the soil (Alberta invasive species council, 2014).

Current management: Digging out the entire plant can be used for its control, however, due to the vigorous reproduction ability of its roots, it needs to be conducted for several years before exhausting the plant (Alberta invasive species council, 2014).

Competitive ability: Creeping bellflower often occupies the ruderal habitats (Hilty, n.d.).

Shade tolerance: Creeping bellflower prefers full to partial sun, and can somehow tolerates the shady area (Alberta invasive species council, 2014).

Soil type: It adapts in well-drained, light sandy to moderate loamy soils with a neutral PH. (Alberta invasive species council, 2014)

Functions:    

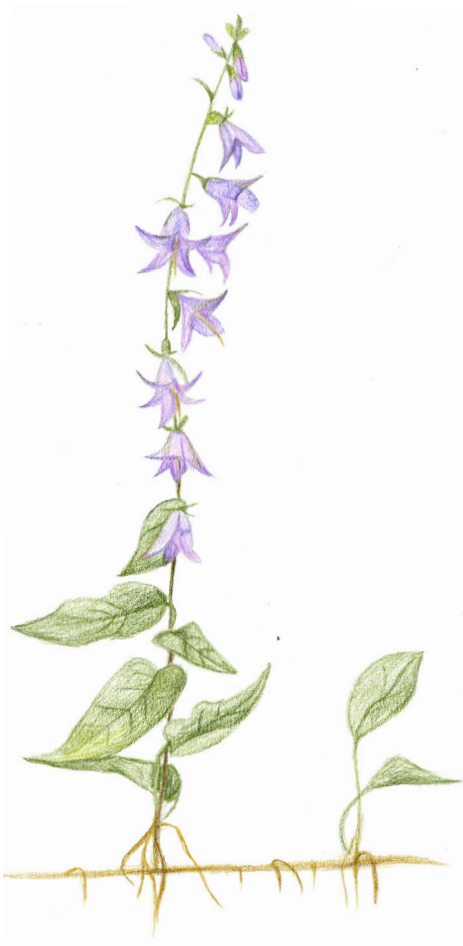


Figure 4.1.9

Shepherd’s purse

Capsella bursa-pastoris

Growth year: Mainly winter annual; summer annual (Hilty, n.d.)

Family: Brassicaceae (Del Tredici, 1945)

Height: 15-50 cm (Manitoba Agriculture, n.d.)

Origin and spread: Shepherd’s purse was introduced to North America from Europe (CABI, n.d.).

Damage: Shepherd’s purse is a common weed in crop fields and highly managed areas (CABI, n.d.). It is particularly a problem in canola and in reduced tillage farming fields (CABI, n.d.; Manitoba Agriculture, n.d.). It is also a host for several pathogens that may cause damage to crops (CABI, n.d.).

Reproduction: Shepherd’s purse is both self-pollinated and cross-pollinated (CABI, n.d.).

It is reproduced only by seeds. It can produce 5000-150,000 seeds per plant, which is determined by competition from other species (CABI, n.d.). Seeds can be easily dispersed by animals by its sticky epidermis in areas of high humidity (CABI, n.d.).

It has a slender taproot that can aerate compacted ground (Roth, 2002).

Current management: Digging out the plant by hand or tools is effective for its control (Roth, 2002). Cultivation can also be used in fall after its germination. (Manitoba Agriculture, n.d.)

Competitive ability: Shepherd’s purse often occupies disturbed and open habitats (CABI, n.d.). Less seeds are produced when competing with other species (CABI, n.d.).

Shade tolerance: It thrives in full sun and is intolerant to shade (CABI, n.d.; Hilty, n.d.).

Soil type: Shepherd’s purse adapts well in mesic to dry conditions and many types of soils. (Hilty, n.d.)

Functions:





Figure 4.1.10

Spotted spurge

Euphorbia maculata

Growth year: Annual (Hilty, n.d.)

Family: Euphorbiaceae (Hilty, n.d.)

Height: Up to 15 cm tall (Hilty, n.d.)

Origin and spread: Spotted spurge is a native plant in North America. (Hilty, n.d.)

Damage: Spotted spurge is poisonous to livestock (Del Tredici, 1945). Its sap can cause irritation to some individuals (Del Tredici, 1945).

Reproduction: Spotted spurge has separate male and female flower on the same plant or occasionally only has male or female flower for a single plant (Hilty, n.d.).

It is reproduced only by seeds (Hilty, n.d.)

Spotted spurge has a thin and weak taproot (Del Tredici, 1945; Hilty, n.d.).

Current management: Digging out or covering the plant by mulch can be used to reduce its growth (Gift, 2011)

Competitive ability: Spotted spurge is a pioneer species that is frequently found in open and disturbed habitats (Gee and Harlos, 2017). It becomes a vertical form when competing with other species (Hilty, n.d.).

Shade tolerance: It thrives in full sun (Hilty, n.d.).

Soil type: Spotted spurge prefers dry conditions and adapts well in sandy, gravel and rocky soils (Hilty, n.d.).

Functions:





Figure 4.1.11

Lamb's quarters

Chenopodium album

Growth year: Annual (Bassett and Crompton, 1978)

Family: Amaranthaceae (Bassett and Crompton, 1978)

Height: 10-250 cm (Bassett and Crompton, 1978)

Origin and spread: Lamb's quarters was thought to be introduced from Europe, but it may be a native species to North America, as recent archaeological study shows its seeds were used by Indigenous people prior to European settlement (Blair, 2014; Manitoba Agriculture, n.d.).

Damage: Lamb's quarters can reduce yield when it competes for resources with many crops, such as barley and wheat (Manitoba Agriculture, n.d.). Its seeds can also be an impurity in cereal seeds (Manitoba Agriculture, n.d.). Lamb's quarter can be toxic to sheep and swine if ingested in large quantities (Bassett and Crompton, 1978). It is also reported the pollen of lamb's quarters can cause hay fever in summer (Bassett and Crompton, 1978).

Reproduction: Lamb's quarters has perfect flowers (Bassett and Crompton, 1978). It can reproduce by both self-pollination and cross-pollination (Bassett and Crompton, 1978). Wind is an important vector for its cross-pollination (Bassett and Crompton, 1978).

The mean number of seeds produced per plant is 72,450 (Bassett and Crompton, 1978). The seeds are more likely to fall beside the parent plant, due to the lack of specialized vectors for their dispersal (Bassett and Crompton, 1978). However, seeds can still be spread by animals as they feed on them and later excrete them, as well as by human activities (Bassett and Crompton, 1978). The seeds of Lamb's quarters can be viable in soils for up to 40 years (Hilty, n.d.).

Current management: The plant won't survive if cut and trampled in the early stage of its life, so the best way to manage it is to exhaust the plant by clipping and cutting before it sets seeds. (Bassett and Crompton, 1978; Hilty, n.d.)

Competitive ability: Lamb's quarters often colonizes the open disturbed habitats, but rarely grows in natural areas, such as native woodland and prairie (Bassett and Crompton, 1978). It has a self-thinning process, the higher density it is, the less seeds it produces without changing seed weight (Bassett and Crompton, 1978).

Shade tolerance: It thrives in full sun, but partial sun is also tolerated (Hilty, n.d.).

Soil type: Lamb's quarters prefers mesic moist condition, fertile loamy soils (Hilty, n.d.). Less rich soil is also tolerable (Hilty, n.d.).

Functions:    



Figure 4.1.12

Oak-leaved goosefoot

Chenopodium glaucum

Growth year: Annual (Hilty, n.d.).

Family: Amaranthaceae (Hilty, n.d.).

Height: 30-75 cm (Hilty, n.d.).

Origin and spread: Oak-leaved goosefoot was most likely introduced from Europe to North America by a ship ballast (Go Botany, n.d.).

Damage: It is regarded as a common weed in turf and gardens.

Reproduction: Flowers are cross-pollinated by wind (Hilty, n.d.).

Oak-leaved goosefoot is reproduced only by seeds, which can be spread long distances by animals as they are viable in their feces (Hilty, n.d.).

It has a shallow taproot with many secondary fibrous roots (Hilty, n.d.).

Competitive ability: Oak-leaved goosefoot often occupy disturbed and exposed ground (Hilty, n.d.).

Shade tolerance: It thrives in full sun and partial sun (Hilty, n.d.).

Soil type: Oak-leaved goosefoot adapts well in many types of soil, from dry to moist, gravel to clay soils (OMAFRA, 2000a). It also tolerates saline soils (OMAFRA, 2000a).

Functions:   



Figure 4.1.13

Canada thistle

Cirsium arvense

Growth year: Perennial (Moore, 1975)

Family: Asteraceae (Moore, 1975)

Height: 30-150 m (Moore, 1975)

Origin and spread: Canada thistle was introduced to Canada from Europe as an impurity in seeds (Moore, 1975).

Damage: Canada thistle is a serious weed in all kinds of agricultural fields (Moore, 1975). Livestock may be scratched by Canada thistle when feeding on it, and it is a host for some pest and pathogens that may cause damage to crops (Moore, 1975).

Reproduction: Canada thistle has male and female flowers on separate plants (Moore, 1975). As female and male plants may be significant distances from each other, there are fewer seeds produced (Moore, 1975). It is primarily reliant on cross-pollination by insects instead of by wind (Moore, 1975).

While it mainly relies on vegetative reproduction, seeds can still be reproduced (Moore, 1975).

There are bristles attached on seeds that can be helpful for their dispersal by wind, the spread distance of which can be up to a distance of 60m (Manitoba Agriculture, n.d.). The seeds can also be spread to long distances by water (Moore, 1975). The mean number of seeds produced per plant is around 700 (Moore, 1975). Their viability is up to three years (Moore, 1975).

Root reproduction is quite vigorous (Moore, 1975). Even a tiny root fragment can give rise to a new plant (Moore, 1975). Canada thistle has a long taproot with many branches that are occasionally up to 6m deep which aids to bring the minerals up to the soil surface (Moore, 1975). It also has several creeping underground roots that can overwinter and continue to spread long distances during the growing season (Moore, 1975). The nodes on the rhizomes can give rise to several vertical shoots and roots, thereby forming new plants when stolon broken apart (Moore, 1975). Thus, a single plant can form a dense clone (Moore, 1975). It overwinters as an underground root system (Moore, 1975).

Current management: Frequent mowing, grazing and cultivation of soil as well as growing with competitive crops can exhaust the species and avoid its emergence (Moore, 1975).

Competitive ability: It is often found in grassy openings in woodlands or at the margins of a forest (Moore, 1975). It is not that competitive in a well-established sward (Moore, 1975). Its seedlings would survive only in bare and open ground and would be outcompeted when shaded by taller vegetations (Moore, 1975).

Shade tolerance: Canada thistle prefers full sun (Moore, 1975). Shading would discourage its growth and reproduction (Moore, 1975).

Soil type: It is found in moist to mesic conditions, clay-loam soils (Hilty, n.d.).

Community: *Medicago sativa* and some forage grasses can compete with Canada thistle (Moore, 1975). It was found associated with *Oxalis sp* (Moore, 1975).

Functions:     



Figure 4.1.14

Canada fleabane

Conyza canadensis

Growth year: Mainly winter annual; summer annual (Weaver, 2001)

Family: Asteraceae (Weaver, 2001)

Height: 10-180 cm (Weaver, 2001)

Origin and spread: Canada fleabane is a native plant in North America (Weaver, 2001).

Damage: Canada fleabane can invade in orchards, vineyards and field crops (Weaver, 2001). It also performs as a host for several pests, thereby causing damage to crops directly, or indirectly playing as a device for plant disease transmission (Weaver, 2001). Its leaves may also give rise to skin irritation to some people (Weaver, 2001).

Reproduction: Canada fleabane mainly relies on self-pollination, while cross-pollination is also possible as some insects are reported to visit the flowers (Weaver, 2001).

It is reproduced only by seeds (Weaver, 2001). The higher the plant is, the more and lighter seeds it produces (Weaver, 2001). Therefore, the tall plant possesses a major advantage for dispersing seeds in wind. The mean number of seeds is around 120,000 per plant (Weaver, 2001). There are bristles attached to seeds that can help dispersal by wind (Weaver, 2001). Seeds can also be spread by water. It is estimated the longevity of seeds is 2-3 years (Weaver, 2001).

It has short taproot with laterals, which can be easily dug out (Weaver, 2001).

Current management: This plant is easy to be dug out, but it is better to do before they develop the seed head (Weaver, 2001).

Competitive ability: It is an early successional plant that frequently occupies disturbed areas (Weaver, 2001). It is not a competitive species in a well-established sward (Weaver, 2001). Because it mainly relies on its winter annual life cycle, it can avoid the competition with summer annuals (Weaver, 2001). It also possesses a phenotypic plasticity feature (Weaver, 2001). As it grows denser, there are less plants flowered and seeded as well as the smaller plant size, but it continues to produce approximately the same number of seeds in total (Weaver, 2001).

Shade tolerance: Canada fleabane prefers full sun spots (Hilty, n.d.).

Soil type: It adapts well in mesic to dry conditions, fertile loamy soils (Hilty, n.d.).

Community: Canada fleabane was often found grown with *Capsella bursa-pastoris* and *Lactuca serriola* in a disturbed area (Weaver, 2001).

Functions:   



Figure 4.1.15

Barnyard grass

Echinochloa crusgalli

Growth year: Annual (Maun and Barrett, 1986)

Family: Poaceae (Maun and Barrett, 1986)

Height: 150 m (Maun and Barrett, 1986)

Origin and spread: Barnyard grass was introduced to North America from Europe (Maun and Barrett, 1986). It is widely distributed in the east of Canada but becomes rare in provinces west of Manitoba (Maun and Barrett, 1986).

Damage: Barnyard can reduce yield and make harvest difficult especially for potatoes and beans (Manitoba Agriculture, n.d; Maun and Barrett, 1986). While there are high labour costs to separate it from potatoes and beans, it is necessary as it can damage harvesting equipment when harvest beans (Maun and Barrett, 1986). It is also an aggressive nitrogen extractor that can remove 60-80% nitrogen from soils (Maun and Barrett, 1986). Moreover, it may become infested in irrigated row crops as its seeds can spread as floating in water. (Maun and Barrett, 1986)

Reproduction: The species is self-compatible and mainly relies on self-pollination but may occasionally be outcrossed by wind dispersal (Maun and Barrett, 1986).

Barnyard grass is only reproduced from seeds (Maun and Barrett, 1986). Its seed production ranges from 2000 to 40,000 per plant (Maun and Barrett, 1986). Water, granivorous birds are all primary means to help seed dispersal (Maun and Barrett, 1986).

Barnyard grass has a fibrous root system (Maun and Barrett, 1986).

Shade tolerance: It thrives in sun and is susceptible to shading (Manitoba Agricultural, n.d.).

Soil type: Barnyard grass prefers moist, rich and neutral soil, but it may still germinate when soil PH range is 4.7-8.3 as well as in drought soil (Maun and Barrett, 1986). Due to its salt tolerance ability, it has been used for reclamation of saline soils. (Duke, 1929)

Community: Barnyard grass was found associated with *Elymus repens*, *Poa pratensis*, *Setaria viridis*, *Taraxacum officinale*, *Trifolium repens* and *Trifolium pretense* along the roadside in Ontario (Maun and Barrett, 1986).

Functions:



Figure 4.1.16

Creeping charlie

Glechoma hederacea

Growth year: Perennial (Hilty, n.d.)

Family: Lamiaceae (Hilty, n.d.)

Height: Up to 30 cm (Hilty, n.d.)

Origin and spread: Creeping charlie was introduced from Europe to North America (Dickinson and Royer, 2014).

Damage: Creeping charlie is a common weed for highly managed areas, such as lawns and gardens.

Reproduction: Creeping charlie is cross-pollinated by insects (Del Tredici, 2010)

It propagates by both seeds and creeping stems (OMAFRA, 2002).The viability of seeds is up to 5 years (Dickinson and Royer, 2014).

The species has a fibrous and shallow root system (Hilty, n.d.). Its creeping stems can root at every node when they reach the soil and thereby give rise to new plants (OMAFRA, 2002).

Current management: Digging out the plant can be used for its control (Wolfin and Koenig, 2017). However, the entire plant must be completely removed from the ground, otherwise remaining root fragments may continue to grow (Wolfin and Koenig, 2017).

Competitive ability: Creeping charlie is often found in a disturbed habitat, but can also sometimes survive in a closed community due to its tolerance of shade. However, it is never a threat for well-established plants and communities (Roth, 2002). It also has allelopathy effects that can decrease the growth of some plants (Wolfin and Koenig, 2017).

Shade tolerance: Creeping charlie tolerates full sun but much prefers shady area (Bebeau, 2014).

Soil type: The species prefers moist fertile loamy soil with soil PH from 5-7.5 (Hilty, n.d.; Wolfin and Koenig, 2017).

Functions:



Figure 4.1.17

Foxtail barley

Hordeum jubatum

Growth year: Perennial (Best, Banting and Bowes, 1978)

Family: Poaceae (Best, Banting and Bowes, 1978)

Height: 30-60 cm (Best, Banting and Bowes, 1978)

Origin and spread: Foxtail barley is a native species in western North America. It has spread across Canada and through two-thirds of the northern United States, However, it is most prevalent in the prairie provinces (Best, Banting and Bowes, 1978).

Damage: Broken segments of the spikelet can lead to pieces of the rachis becoming sharp point that may cause injury in mouth tissues, nostrils or eyes of foraging animals in pastures (Best, Banting and Bowes, 1978). It is also a host for wheat and black stem rust which may cause damage to field crops (Best, Banting and Bowes, 1978).

Reproduction: It is self-compatible and self-pollinated (Best, Banting and Bowes, 1978).

The plant is only reproduced by seeds, and produces more than 180 per plant (Best, Banting and Bowes, 1978). The longevity of seeds is up to 7 years (Best, Banting and Bowes, 1978).

Foxtail barley has a fibrous root system (Best, Banting and Bowes, 1978).

Competitive ability: The species has a competitive advantage as it usually germinates during fall and winter, thereby making its seeds easily dispersed to a long distance to occupy new areas (Best, Banting and Bowes, 1978). It is not that competitive compared with taller plants (Best, Banting and Bowes, 1978).

Shade tolerance: Foxtail barley prefers full sun (Hilty, n.d.).

Soil type: The plant grows well in moist to moderate dry condition, clay, loamy clay, gravel soils and also prefers fertile soils. (Best, Banting and Bowes, 1978; Hilty, n.d.) It adapts to a variety of water tables and it tolerates moderate saline and alkaline soils (Best, Banting and Bowes, 1978).

Functions:



Figure 4.1.18

Kochia

Kochia scoparia

Growth year: Annual (Friesen, et al., 2009)

Family: Amaranthaceae (Friesen, et al., 2009)

Height: 30-180 cm (Friesen, et al., 2009)

Origin and spread: Kochia was originally introduced to North America from Eurasia for its ornamental value (Friesen, et al., 2009).

Damage: Kochia can compete fiercely with cool-season cereal crops (Friesen, et al., 2009).The allelopathic effect of this plant can also inhibit the growth of some crops (Friesen, et al., 2009). Kochia is toxic if consumed a large amount by animals (Friesen, et al., 2009). Some individuals may also be allergic to its pollen (Friesen, et al., 2009).

Reproduction: Flowers are self-compatible, but wind and bees can also contribute to its cross-pollination (Friesen, et al., 2009). Wind is a major device for pollen dispersal which can carry them to a long distance (Friesen, et al., 2009).

The mean number of seeds produced per plant is 20,000 (Friesen, et al., 2009). When stems break and tumble in autumn winds, seeds are able to be dispersed over long distance, colonizing new habitats (Friesen, et al., 2009). Its seeds are viable for 1-2 years in soil (Friesen, et al., 2009).

Its taproot can be up to 5 m long (Friesen, et al., 2009).

Current management: Mowing would be a quite effective control way if adopted before the species starting setting seeds (Friesen, et al., 2009).

Competitive ability: Kochia is one of the first successional plants in disturbed area (Friesen, et al., 2009). It does not survive in close communities such as forests and healthy pastures (Friesen, et al., 2009). Allelochemicals, which perform as a protective mechanism to detract animals from feeding on the plant, may also inhibit the growth of Kochia itself. A long-term imbalance of P, Mn and Zinc in soil would not provide the best environment for the plant, unless that soil had further disturbance (Friesen, et al., 2009). The allelochemicals released would also discourage the growth of its neighboring plants (Friesen, et al., 2009). The competition with other plants also influences the morphology of Kochia, as it would appear to be a much taller, less stemmed plant when competing with other vegetation as compared to when there is less competition (Friesen, et al., 2009).

Shade tolerance: Kochia grows well in full sun (Friesen, et al., 2009).

Soil type: The plant prefers moist to dry condition, sandy or gravel soils (Friesen, et al., 2009; Hilty, n.d.). It also tolerates saline soil and soils with an extreme high PH (Friesen, et al., 2009; Hilty, n.d.). It is an aggressive extractor of nitrogen in soil (Friesen, et al., 2009).

Functions:



Figure 4.1.19

Prickly lettuce

Lactuca seriola

Growth year: Mainly winter annual; summer annual (Weaver and Downs, 2003)

Family: Asteraceae (Weaver and Downs, 2003)

Height: 50-150 cm (Weaver and Downs, 2003)

Origin and spread: Prickly lettuce was introduced to North America from Europe (Weaver and Downs, 2003).

Damage: Prickly lettuce is a common weed for numerous crops (Weaver and Downs, 2003). The young plant of Prickly lettuce may cause pulmonary emphysema to cattle (Weaver and Downs, 2003).

Reproduction: The plant is self-compatible and primarily self-pollinated (Weaver and Downs, 2003). The number of flowers is found positively associated with plant height (Weaver and Downs, 2003).

It is reproduced only by seeds and each plant produces up to 200,000 per plant (Weaver and Downs, 2003). The winter annual can produce much more seeds than summer annual (Weaver and Downs, 2003). Its seeds are mainly dispersed by wind as facilitated by bristles attached on achenes of its tall stems (Weaver and Downs, 2003). However, a neighboring tall plant can block the distribution (Weaver and Downs, 2003). Seeds can also be dispersed by water (Weaver and Downs, 2003). It only has a short seed bank which is around 1 to 3 years. It overwinters as seeds or rosette (Weaver and Downs, 2003).

Prickly lettuce has a long taproot with a rosette on the ground (Weaver and Downs, 2003).

Current management: As its rosette is closed to the ground, mowing is not an effective way to get rid of it, because the stem can be reproduced from the rosette (Weaver and Downs, 2003). Digging out the entire plant is a way to control its spread in gardens (Roth 2002).

Competitive ability: Prickly lettuce is a ruderal species that tends to occupy the open and disturbed ground (Weaver and Downs, 2003). In a growing sward, its biomass would be discouraged by other species, while the number of its seedling establishment may not be influenced (Weaver and Downs, 2003). It is more likely to form a dense population in less fertile soil, as there is less competition from other species (Weaver and Downs, 2003). Its winter annual life cycle avoids its competition with summer annuals (Weaver and Downs, 2003).

Shade tolerance: Prickly lettuce thrives in full sun (Hilty, n.d).

Soil type: The species adapts well from mesic to dry soils, which is either fertile or sterile (Hilty, n.d).

Community: Prickly lettuce was found to be associated with *Capsella bursa-pastoris*, *Conyza canadensis* and *Polygonum aviculare* in recent disturbed areas (Weaver and Downs, 2003).

Functions:



Figure 4.1.20

Yellow toadflax

Linaria vulgaris

Growth year: Perennial (Saner, 1994)

Family: Plantaginaceae

Height: 25 -80 cm (Saner, 1994)

Origin and spread: Yellow toadflax was introduced from Europe to North America for its ornamental value, which further contributed to its spread in North America (Saner, 1994).

Damage: The plant is a common weed for agricultural fields, especially for annual crops if a low tillage farming method is used. It is also resistant to some herbicides and can harbor pests which would cause severe damage to crops (Saner, 1994). Moreover, it is unpalatable to cattle in pasture (Saner, 1994).

Reproduction: The plant is self-sterile and primarily cross-pollinated by insects (Saner, 1994).

Yellow toadflax mainly relies on vegetative reproduction, even though it can also reproduce from seeds (Saner, 1994). The average number of seeds produced per plant is 15,750 (Saner, 1994). Though it is possible for its seeds to be dispersed to a long distance by animals, water and wind during the winter, most seeds of yellow toadflax fall beside parent plants in growing season (Saner, 1994). Seeds can become dormant and maintain their viability for over eight years (Saner, 1994).

It has a long taproot (up to 1m) with many superficial roots, which enables it to aerate compacted soil, tolerate the drought soil and stand firmly (Del Tredici, 1945; Saner, 1994). Its vegetative reproduction is quite vigorous (Saner, 1994). Every root bud either on tap roots or lateral roots may give rise to a new plant, and even a tiny root fragment left in ground may lead to the regrowth (Saner, 1994). It relies on taproot in perennation (Saner, 1994).

Current management: Mowing before flowering and tilling before the vegetative stage can effectively control the yellow toadflax by prohibiting seed production and exhausting its root system (Saner, 1994).

Competitive ability: Yellow toadflax is found frequently in disturbed and open habitat (Saner, 1994). When growing with other tall species, it relies on vegetative reproduction, even though it is less vigorous, producing less seeds (Saner, 1994). Grasses compete successfully with this species (Saner, 1994). An increase of potassium in the soil may decrease the population of Yellow toadflax, whereas an increase of nitrogen in soil would benefit its growth (Saner, 1994). It is a strong competitor on the prairie, as it quickly colonizes open ground by seed dispersal and then persists by root reproduction (Saner, 1994).

Shade tolerance: It thrives in full sun, but tolerates shade. (Hilty, n.d., Saner, 1994)

Soil type: Yellow toadflax prefers moist and fertile soil, however, it is more likely to be outcompeted in such conditions (Saner, 1994). It also adapts to dry, gravel and sand soil and would be more persistent, though more stunted (Hilty, n.d., Saner, 1994). It can tolerate a high PH and saline soil (Hilty, n.d., Saner, 1994)

Functions:



Figure 4.1.21

Birdsfoot trefoil

Lotus corniculatus

Growth year: Perennial (Turkington, Roy and Franko, 1980)

Family: Fabaceae (Turkington, Roy and Franko, 1980)

Height: 15-60 cm (Hilty, n.d.)

Origin and spread: Birdsfoot trefoil was introduced from Europe to North America as an impurity in ballasts and forage seeds (Turkington, Roy and Franko, 1980).

Damage: The species is regarded as a common weed in highly-managed areas, such as turf and lawn.

Reproduction: It is mainly dependent on cross-pollinated by insects, while self-pollination is rare (Turkington, Roy and Franko, 1980).

Birdsfoot trefoil reproduces by both seeds and vegetative means (Turkington, Roy and Franko, 1980). The seeds can be violently ejected from pods, and moved long distances when consumed by animals (Turkington, Roy and Franko, 1980).

It has a long taproot (up to 1m) with many branched roots to form a fibrous root mat (Turkington, Roy and Franko, 1980). It also forms tillers and rhizomes underground which would give rise to a new plant (Turkington, Roy and Franko, 1980). The stems and roots left in soil may possibly continue to grow, especially when nodes are attached (Turkington, Roy and Franko, 1980).

Current management: Constant removal of the upper part of the plant would exhaust its growth and inhibit seeds production (Turkington, Roy and Franko, 1980). However, the cutting of the upper part may also stimulate the growth buds and shoots from its root system (Turkington, Roy and Franko, 1980).

Competitive ability: Birdsfoot trefoil can outcompete other legumes in poor soil by its deep taproot with many shallow fibrous root system as well as hard covered seeds (Turkington, Roy and Franko, 1980). However, when grown in fertile soil, it becomes less vigorous, as it is easily to be outcompeted by taller species (Turkington, Roy and Franko, 1980).

Shade tolerance: The plant prefers full sun to partial sun (Hilty, n.d.); shade discourages its growth (Turkington, Roy and Franko, 1980).

Soil type: Birdsfoot trefoil thrives in mesic conditions with rich loam and clay-loam soils with a PH of 6.5, but it also tolerates dry to moist conditions, saline, acidic, calcareous, less fertile and sandy soils. (Del Tredici, 1945; Hilty, n.d.; Turkington, Roy and Franko, 1980)

Community: The species is found associated well with *Poa pratensis* in pasture (Turkington, Roy and Franko, 1980).

Functions:



Figure 4.1.22

Round-leaved mallow

Malva pusilla

Growth year: Annual (Makowski and Morrison, 1989)

Family: Malvaceae (Makowski and Morrison, 1989)

Height: The plant is often in a prostrate form (Makowski and Morrison, 1989)

Origin and spread: Round-leaved mallow was introduced from Europe to North America and is widely distributed in the prairie provinces of Canada (Makowski and Morrison, 1989).

Damage: The species can reduce yield for crops, especially for flax, lentil and wheat in the prairie provinces (Makowski and Morrison, 1989).

Reproduction: Round-leaved mallow is primarily self-pollinated (Makowski and Morrison, 1989).

It is reproduced only by seeds (Makowski and Morrison, 1989). The average number of seeds produced when growing in a pure stand is 3,454, while only 324 seeds are produced when growing with wheat (Makowski and Morrison, 1989). The hard seed coat of Round-leaved mallow needs time to break down and avoids the seeds germinating right away (Makowski and Morrison, 1989). Therefore, it has a persistent seed bank which may possibly be up to more than 100 years (Makowski and Morrison, 1989).

Round-leaved mallow has a strong and long taproot, which enables the plant to tolerate the drought (Makowski and Morrison, 1989).

Current management: Unless the taproot is severely damaged underground, it will continue to grow (Makowski and Morrison, 1989). Mowing and grazing will result in the vigorous regrowth of more branches in a long term (Makowski and Morrison, 1989).

Competitive ability: The species is not that competitive with taller grasses, unless in a site with a high nutrient level (Makowski and Morrison, 1989). When growing with taller grasses, it appears to be a more vertical form that can appear as the same height as grasses, but its growth would be less vigorous (Makowski and Morrison, 1989). In contrast, its growth spreads, and it is highly reproductive with growing alone (Makowski and Morrison, 1989).

Shade tolerance: The Round-leaved mallow thrives in full sun areas (Makowski and Morrison, 1989).

Soil type: Even though it tolerates drier soil, it prefers moist, rich loamy soil (Hilty, n.d. ; Makowski and Morrison, 1989; Manitoba Agriculture, n.d.)

Functions:



Figure 4.1.23

Scentless chamomile

Matricaria perforata

Growth year: Annual or short-lived perennial (Thomas, et al, 1991)

Family: Asteraceae (Thomas, et al, 1991)

Height: 15-100 cm (Thomas, et al, 1991)

Origin and spread: Scentless chamomile was introduced to North America as an impurity in crops seeds or for its value as an ornamental plant (Thomas, et al, 1991). It is prevalent in prairie provinces and east coasts of Canada (Thomas, et al, 1991).

Damage: The plant is a common weed in crop fields, but not that vigorous in comparison to other weeds (Thomas, et al, 1991). It is unpalatable to livestock (Thomas, et al, 1991).

Reproduction: The species is self-incompatible and only relies on cross-pollination by insects instead of wind, due to its heavy and sticky pollen (Thomas, et al, 1991).

It is reproduced only by seeds and each plant produces up to 3,200 per plant (Thomas, et al, 1991). When seeds mature, they fall on ground near the parent plant and are possibly dispersed by wind later. Water dispersal is also possible (Thomas, et al, 1991). Animals can also play as an important agent for seed dispersal as seeds are still viable after going through their digestive tract (Thomas, et al, 1991). The viability of seeds is more than 10 years (Hilty, n.d).

Scentless chamomile has dense fibrous roots (Thomas, et al, 1991).

Current management: Tillage in late fall and early spring is recommended for its control (Thomas, et al, 1991). Bromegrass can decrease the growth of scentless chamomile if seeded together (Thomas, et al, 1991). Mowing before flowering can also control the spreading of this plant (Thomas, et al, 1991).

Competitive ability: The species is found in both open and dense communities (Thomas, et al, 1991). Due to its phenotypical plastic trait, it tends to have a more spreading branches if there are less competition from nearby plants, while it develops a much vertical and slender form if there are other vigorous species nearby (Thomas, et al, 1991).

Shade tolerance: Scentless chamomile thrives in full sun.

Soil type: The species adapts in moist to moderate dry soils (Hilty, n.d). It is found in clay, clay-loam, silty clay-loam, loam and sandy loam in the West (Thomas, et al, 1991). It tolerates to PH from 5.5-7.9 (Thomas, et al, 1991).

Functions:  



Figure 4.1.24

Black medick

Medicago lupulina

Growth year: Annual, biennial or short-lived perennial (Turkington, Roy and Cavers, 1979)

Family: Fabaceae (Turkington, Roy and Cavers, 1979)

Height: Up to 45 cm tall (Hilty, n.d.).

Origin and spread: Black medick was introduced to North America from Europe, probably as a pasture mixture or a contaminant of seeds (Turkington, Roy and Cavers, 1979). It has spread widely across Canada, but it's less prevalent in prairie provinces (Turkington, Roy and Cavers, 1979).

Damage: The plant is a prevalent weed in agricultural fields, gardens and turf (Turkington, Roy and Cavers, 1979). Its seeds are often an impurity for forage crops (Turkington, Roy and Cavers, 1979).

Reproduction: Black medick is both self-pollinated or cross-pollinated by bees or wind (Turkington, Roy and Cavers, 1979).

It is reproduced only by seeds (Turkington, Roy and Cavers, 1979). The mean number of seeds produced is 2,510 for a lawn population (Turkington, Roy and Cavers, 1979). Seeds can be dispersed to a long distance by water, animals and human agents (Turkington, Roy and Cavers, 1979). And wind dispersal is less important (Turkington, Roy and Cavers, 1979). The seeds can become dormant and still be viable after many years (Turkington, Roy and Cavers, 1979).

It has a slender taproot with many lateral roots (up to 60cm in depth) which form a mat (Turkington, Roy and Cavers, 1979).

Current management: Mowing is ineffective as Black medick is too close to the ground (Turkington, Roy and Cavers, 1979). However, it can be controlled by digging out or sowed together with other species (Gift, 2011; Turkington, Roy and Cavers, 1979).

Competitive ability: It is a ruderal species that tends to occupy bare ground and is favoured when there is less competition from other species (Turkington, Roy and Cavers, 1979). It was not that competitive compared with other legumes, such as Red clover, White clover, Alfalfa and Birdsfoot trefoil (Turkington, Roy and Cavers, 1979). When sowed together, it would become dominant in the first year but would be crowded out in later years, which reflect its trait to be as a pioneer species (Turkington, Roy and Cavers, 1979). However, if this species is grown in certain densities, other species have difficulty dominating Black medick (Turkington, Roy and Cavers, 1979).

Shade tolerance: Black medick prefers full sun and partial sun (Hilty, n.d.)

Soil type: It adapts well in moist to dry conditions, loam, clay-loam and gravel soils and soil with a PH from 6.5-7.8 (Del Tredici, 1945; Hilty, n.d.; Turkington, Roy and Cavers, 1979). It also tolerates dry soil, but will not survive in saline soil (Del Tredici, 1945; Turkington, Roy and Cavers, 1979).

Community: *Poa annua*, *Glechoma hederacea* are positively associated with Black medick, while *Taraxacum officinale*, *Trifolium repens*, *Medicago sativa* are negatively associated with this species in a grassland in London, Ontario, though they grow closely together. Black medick was also found grown together with *Trifolium repens*, *Trifolium pratense*, *Melilotus alba*, *Melilotus officinalis*, *Medicago sativa*, *Lotus corniculatus*, *Elymus repens* and *Aster sp.* in London, Ontario.

Functions:    



Figure 4.1.25

Alfalfa

Medicago sativa

Growth year: Perennial (Hilty, n.d.)

Family: Fabaceae (Hilty, n.d.)

Height: 30-75 cm (Hilty, n.d.)

Origin and spread: Alfalfa was introduced from Europe to North America for its forage values (Hilty, n.d.).

Damage: Even though Alfalfa is treasured as a forage in pasture, it is regarded as a weed in turf and gardens.

Reproduction: Flowers are cross-pollinated by insects (Hilty, n.d.).

The plant is reproduced only by seeds (Hilty, n.d.).

It has a thick long taproot that can breakdown compacted ground and bring nutrients up to the soil surface.

Competitive ability: Alfalfa is a frequent colonizer for open disturbed habitats (Hilty, n.d.). It is not that competitive with taller vegetation (Hilty, n.d.).

Shade tolerance: The plant thrives in full sun (Hilty, n.d.).

Soil type: Alfalfa grows well in medium to slight dry conditions, in many kinds of soils (Hilty, n.d.). It can also adapt to moist soil if there is not much competition from nearby taller plants (Hilty, n.d.).

Functions:





Figure 4.1.26

White sweet clover

Melilotus alba

Growth year: Annual or biennial (Turkington, et al, 1978)

Family: Fabaceae

Height: 90-240cm (Hilty, n.d)

Origin and spread: White sweet clover is native to the Mediterranean region through central Europe to Tibet and was introduced to North America to be as a forage crop (Turkington, et al, 1978). It is widely distributed across Canada (Turkington, et al, 1978).

Damage: The plant is regarded as a weed for wheat (Turkington, et al, 1978). Grazing on decaying sweet-clover may cause cattle to bleed, due to the conversion of coumarin to dicoumarol (anticoagulant) by fungi (Turkington, et al, 1978).

Reproduction: Even though it can self-pollinate, it is primarily pollinated by insects, especially bees (Turkington, et al, 1978). Due to its large quantity of pollen production, the species is used for honey production (Turkington, et al, 1978).

White sweet clover is reproduced only by seeds (Turkington, et al, 1978). The mean number of seeds produced with little competition is 275,000, while under unfavorable condition such as growing in poor soil and having competition from other plants, it can produce less than 100 seeds (Turkington, et al, 1978). Even though its seeds can be dispersed long distances by wind, it is more likely to be carried by water flow (Turkington, et al, 1978). Its seeds are viable up to 20 years (Turkington, et al, 1978).

Its stout, long deep tap root enables the species stand the drought and overwinter, thereby contributing to the rapid growth of stems in the spring (Turkington, et al, 1978). The long taproot is also able to penetrate compacted soil (Del Tredici, 1945). It also has many lateral roots that help to firm the species in wind (Turkington, et al, 1978).

Current management: Mowing benefits its growth (Turkington, et al, 1978). Cutting White sweet clover in the same year as it is seeded, reduces its competitive ability in the following year (Turkington, et al, 1978). Moreover, if removing the top before the growth of roots and crowns in late summer, its growth would be reduced (Turkington, et al, 1978).

Competitive ability: Perennial species will outcompete White sweet clover if grown together, as its seedlings would be unable to survive (Turkington, et al, 1978). The species adapts well in disturbed and open habitat where there is less competition from other plants (Turkington, et al, 1978). If grown with other vigorous plants, its seedling mortality is high (Turkington, et al, 1978). However, in its second-year growth it can be quite competitive to the annual seedlings (Turkington, et al, 1978). A pure stand of sweet clover is often invaded by other species (Turkington, et al, 1978).

Shade tolerance: The plant is intolerant of shade (Turkington, et al, 1978).

Soil type: White sweet clover is found growing in many types of soil, including clay, loam, sand and river gravel, but it prefers rich loam and clay-loam (Turkington, et al, 1978). However, its seedlings are more likely to be eliminated by nearby plants when growing in fertile soil (Turkington, et al, 1978). It also adapts to calcareous, saline and high boron content soil (Turkington, et al, 1978). It can tolerate dry and somewhat infertile soil, but requires enough moisture for germination (Turkington, et al, 1978). Deficiency of sulphur may inhibit its growth (Turkington, et al, 1978).

Functions:





Figure 4.1.27

Yellow sweet clover

Melilotus officinalis

Growth year: Annual or biennial (Turkington, et al, 1978)

Family: Fabaceae

Height: 60-200 cm (Hilty, n.d.)

Origin and spread: Yellow sweet clover is native in the Mediterranean through central Europe to Tibet, and was introduced from Eurasia to North America (Turkington, et al, 1978).

Damage: It is considered as a weed for barley in Saskatchewan (Turkington, et al, 1978). Like White sweet clover, feeding on spoiled sweet-clover may cause 'bleeding disease' to cattle (Turkington, et al, 1978).

Reproduction: Flowers are self-incompatible and cross-pollinated by insects (Turkington, et al, 1978). It is also recognized for its value for honey production, even though it contains less pollen compared with White sweet clover (Turkington, et al, 1978).

Yellow sweet clover, which is only reproduced by seeds produces up to 100,000 seeds per plant (Turkington, et al, 1978). However, just like White sweet clover, if growing in infertile soil and having competition from other plants it would produce less than 100 seeds (Turkington, et al, 1978). Water is a more important course for its seeds dispersal compared with strong wind (Turkington, et al, 1978). The viability of its seeds is up to 20 years (Turkington, et al, 1978).

Yellow sweet clover has a strong tap root, which is more than 120 cm deep and is able to penetrate compacted soil, which helps the species withstand drought and overwinter (Del Tredici, 1945; Turkington, et al, 1978). The horizontal roots of this species make it is able to stand in windy climate (Turkington, et al, 1978).

Current management: Mowing favors its growth (Turkington, et al, 1978).

Competitive ability: Like White sweet clover, it would be eliminated if grown with perennial species (Turkington, et al, 1978). It is often found in habitats with less competition such as disturbed and bare ground, because if grown with other vigorous plant, its seedling mortality is high (Turkington, et al, 1978). However, in its second-year growth it can be quite competitive to the annual seedlings (Turkington, et al, 1978). The pure stand of sweet clover is also often invaded by other species (Turkington, et al, 1978). Yellow sweet clover is reported as an early successional plant for asbestos and gypsum tips (Turkington, et al, 1978).

Shade tolerance: Yellow sweet clover is susceptible to shade (Turkington, et al, 1978).

Soil type: The species tolerates salt, dry, high boron content and less fertile gravel and sandy soil, but its seedlings need enough moisture for emergence (Turkington, et al, 1978). It much prefers fertile loam and clay soil for growth, but it's seedlings will not survive if there is fierce competition from neighboring plants (Turkington, et al, 1978). It also grows well in calcareous soil. A lack of sulphur would discourage its growth (Turkington, et al, 1978).

Community: It is found associated with *Elymus repens*, *Medicago lupulina*, *Taraxacum officinale*, *Trifolium repens*, *Trifolium pratense*.

Functions:



Figure 4.1.28

Pineapple weed

Matricaria discoidea

Growth year: Annual (Hilty, n.d)

Family: Asteraceae (Manitoba Agriculture, n.d.)

Height: 7-30 cm (Hilty, n.d)

Origin and spread: Pineapple weed is a native species in Asia or Pacific Northwest (Minnesota wildflowers, n.d).

Damage: It is often regarded as a weed in turf and lawns.

Reproduction: It propagates by seed production (Hilty, n.d). Its seeds are gelatinous, so they are easily dispersed by animals when they attach to fur in moisture conditions. Seeds can also be dispersed by water and human agents.

The plant has a branching taproot (Hilty, n.d).

Competitive ability: Pineapple weed adapts well in disturbed habitats (Hilty, n.d). It is not that competitive with taller vegetation and rarely found in a closed community. (Hilty, n.d). It is less aggressive compared with other weeds.

Shade tolerance: Pineapple weeds prefers full sun and is susceptible to shade (Hilty, n.d).

Soil type: The species prefers mesic conditions, gravel and compacted soil (Hilty, n.d).

Community: Pineapple weeds were found associated with *Polygonum aviculare* and *Plantago major* in heavy traffic areas in Winnipeg.

Functions:

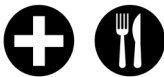


Figure 4.1.29

Yellow woodsorrel

Oxalis stricta

Growth year: Perennial (Lovett Doust, MacKinnon and Lovett Doust, 1985)

Family: Oxalidaceae (Lovett Doust, MacKinnon and Lovett Doust, 1985)

Height: 5-40 cm (Lovett Doust, MacKinnon and Lovett Doust, 1985)

Origin and spread: Yellow woodsorrel is possibly native in eastern Canada, and later introduced to central and western Canada (Lovett Doust, MacKinnon and Lovett Doust, 1985).

Damage: It is a common weed in crop fields (Lovett Doust, MacKinnon and Lovett Doust, 1985).

Reproduction: Flowers are self-pollinated (Lovett Doust, MacKinnon and Lovett Doust, 1985).

The plant reproduces by both seeds and rhizomes (Lovett Doust, MacKinnon and Lovett Doust, 1985). The seeds can be violently ejected from the carpel to a distance of 2m from the parent plant (Lovett Doust, MacKinnon and Lovett Doust, 1985).

The species has rhizomes that can give rise to new plant from buds, but it is without a taproot (Lovett Doust, MacKinnon and Lovett Doust, 1985).

Current management: Hand pulling is effective before the growth of rhizomes on its seedlings (Lovett Doust, MacKinnon and Lovett Doust, 1985). Hand tools can also be adopted to help remove the plant after vegetative stage, even though it can be difficult to extract the entire plant (Lovett Doust, MacKinnon and Lovett Doust, 1985; Roth 2002)

Competitive ability: The species is often found in ruderal or disturbed habitats, such as grasslands and the margins of forests (Lovett Doust, MacKinnon and Lovett Doust, 1985). It germinates from seeds in a disturbed area, while it mainly relies on vegetative reproduction in a growing community (Lovett Doust, MacKinnon and Lovett Doust, 1985).

Shade tolerance: It prefers full sun (Hilty, n.d.).

Soil type: Yellow woodsorrel tolerates many types of soil, but adapts well in loam, clay-loam, gravelly loam and sandy loam soils (Lovett Doust, MacKinnon and Lovett Doust, 1985; Hilty, n.d.). It prefers dry mesic to mesic conditions (Hilty, n.d.).

Community: Yellow woodsorrel is found associated with *Elymus repens* and *Medicago sp.* in tall vegetation in Ontario (Lovett Doust, MacKinnon and Lovett Doust, 1985).

Functions:    



Figure 4.1.30

Broad-leaved plantain

Plantago major

Growth year: Annual, biennial or perennial (Hawthorn, 1974)

Family: Plantaginaceae (Kaulbars, 2000)

Height: 8-30 cm (Minnesota Wildflowers, n.d.)

Origin and spread: Broad-leaved plantain was introduced to North America from Europe and is widely distributed in Canada (Dickinson and Royer, 2014).

Damage: The plant is a common weed for crop fields and highly managed areas, such as lawns and gardens (Hawthorn, 1974). It is a host for some pathogens that may cause damage to crops. Its pollen may also cause hay fever if spread in large quantity (Hawthorn, 1974).

Reproduction: Flowers can be self-pollinated or cross-pollinated by wind (Hawthorn, 1974).

It is a hemicryptophytes. While it is possible to be reproduced by vegetative means, it happens rarely (Hawthorn, 1974). On the contrary, it mainly relies on seeds production (Hawthorn, 1974). It can produce up to 14,000 seeds per plant (Hawthorn, 1974). The mucilage on the seeds coat make the seeds easier to be attached to the fur or feather of animals in wet condition, thereby enabling them to be dispersed to a long distance (Hawthorn, 1974). The viability of its seeds can be more than 40 years, if buried in soil (Hawthorn, 1974).

The species has a fibrous root system which is up to 80 cm in depth and in width and can make the plant tolerant to drought (Hawthorn, 1974). Some variants are reported to develop ramets from buds on the crown in the roadsides and disturbed ground, thereby giving rise to a new plant when bonds are broken apart and the ramet start to root itself (Hawthorn, 1974). However, it wouldn't be reproduced by ramets in a pasture habitat (Hawthorn, 1974). The plant often shows up as a small or big clump as its off-spring often stays close to the parent plant (Hawthorn, 1974).

Current management: Mowing in grass sward can temporarily benefit this plant, as taller species are removed (Hawthorn, 1974). Digging out the entire plant is nearly impossible accounting to its extensive fibrous roots. Its root system aerates the soil, alleviating soil compaction (Gift, 2011). A layer of mulch over soil can be adopted to control the plant (Gift, 2011).

Competitive ability: Broad-leaved plantain can quickly occupy the disturbed and trampled ground (Hawthorn, 1974). It would be outcompeted by perennial species (Hawthorn, 1974). When grown with perennial herbaceous plants, the mortality of its seedlings is quite high (Hawthorn, 1974). Its vegetative reproduction would be quickly reduced if there was fierce competition from nearby species (Hawthorn, 1974). The plant can reach one foot tall in bare ground, while it would appear to be short and flat in a mowing lawn (Hawthorn, 1974).

Shade tolerance: It thrives in full sun and be susceptible to the shade (Hawthorn, 1974).

Soil type: The plant adapts well in many kinds of soil, including clay, loam and sand, compacted and dry soils (Gift, 2011; Hawthorn, 1974). It most prefers moist and rich soils (Del Tredici, 2010). It grows well in dry mesic prairie (Hawthorn, 1974).

Community: Broad-leaved plantain was found associated with *Poa annua* and *Trifolium repens* in a pasture in Netherlands (Hawthorn, 1974). It grows respectively with *Aster sp*, *Achillea millifolium*, *Medicago lupulina*, *Medicago sativa*, *Oxalis stricta*, *Poa pratensis*, *Taraxacum officinale*, *Trifolium repens*, *Trifolium pratense* in a 12 years old pasture and *Aster sp*, *Artemisia absinthium*, *Cirsium arvense*, *Medicago lupulina*, *Medicago sativa*, *Oxalis stricta*, *Poa pratensis*, *Taraxacum officinale*, *Trifolium repens*, *Trifolium pratense* in a ploughed fallow pasture in London Ontario (Hawthorn, 1974).

Functions:     



Figure 4.1.31

Annual bluegrass

Poa annua

Growth year: Annual or short-lived perennial (Warwick, 1979)

Family: Poaceae (Warwick, 1979)

Height: 2-40 cm (Warwick, 1979)

Origin and spread: Annual bluegrass is considered to have originated in the Mediterranean region and was introduced to North America from Europe (Warwick, 1979). It spreads widely throughout the southern regions of Canada (Warwick, 1979).

Damage: Annual bluegrass is a common weed in crop fields and turf (Warwick, 1979). Its pollen is also a severe source for hay fever in Europe and Colorado (Warwick, 1979). It is also a host for a wheat fungus, which may cause damage to the wheat (Warwick, 1979). Currently, there is no targeted herbicide to get rid of this species (Warwick, 1979).

Reproduction: It is self-compatible and primarily self-pollinated, though cross-pollination may occasionally occur (Warwick, 1979).

There are two forms of *Poa annua*, one is an erect annual form, another is the prostrate perennial (Warwick, 1979). While the annual relies on seeds for reproduction, the perennial reproduces by both seeds and roots, and depends more on vegetative propagation (Warwick, 1979). They are not two subspecies but tend to occur together and the distribution of which is decided by certain habitat (Warwick, 1979). For example, whereas the annual variant tends to occupy open habitat, there can be more perennials in closely mown turf (Warwick, 1979).

The seeds produced per plant can be up to 8,000 (Warwick, 1979). Birds and human agents are all important vectors for its seeds dispersal (Warwick, 1979). The seeds can also be carried by wind, due to their light weight (Warwick, 1979).

The perennial form of Annual bluegrass can develop the root from nodes on its shoots in the fall (Warwick, 1979). The shoots would fall to the ground due to the heavy root and in the next spring, when shoots are detached from the parent plant, a new plant emerges (Warwick, 1979).

Current management: Cultivation can increase seeds germination, because it brings the seeds to the surface of soil (Warwick, 1979). Mowing can benefit the growth of Annual bluegrass, especially for the perennial variant (Warwick, 1979). Digging out the plant can also be adopted for the control of this species (Warwick, 1979).

Competitive ability: Annual bluegrass tends to occupy open and partially shaded habitat but rarely shows up in a closed community (Warwick, 1979). It adapts well in stressful conditions, such as heavy pollution, extreme temperature and moisture (Warwick, 1979). Due to its high tolerance of compacted soil, it is often found in highly trampled ground (Warwick, 1979). The annual variant is much more or less stress-tolerant than the perennial forms (Warwick, 1979). It has a self-thinning effect, when grown in higher density, the mortality of seedlings increases and the seeds production decreases (Warwick, 1979).

Shade tolerance: Annual bluegrass adapts well in both sunny and partial shaded areas (Warwick, 1979).

Soil type: The species can grow in many types of soil, from clays to sand (Warwick, 1979). It tolerates high moist and saline soils.(Del Tredici, 1945; Warwick, 1979). Annual bluegrass doesn't do well in acidic soil as it prefers fertile, rich soil (Warwick, 1979).

Functions: 



Annual form



Perennial form

Figure 4.1.32

Prostrate knotweed

Polygonum aviculare

Growth year: Annual (Costea and Tardif, 2005)

Family: Polygonum (Hilty, n.d.)

Height: Stems are prostrate to erect, 6 to 200 cm long (Costea and Tardif, 2005).

Origin and spread: Prostrate knotweed was introduced to North America from Europe (Costea and Tardif, 2005).

Damage: It is a common weed for agricultural fields and highly -managed sites such as turf and gardens. It is a host for several pest and pathogens that may cause damage to crops (Costea and Tardif, 2005). Prostrate knotweed was reported in Europe, to be herbicide resistant (Costea and Tardif, 2005).

Reproduction: The species can be both self-pollinated or cross-pollinated by insects (Costea and Tardif, 2005).

It is reproduced only by seeds and each plant produces a range from 125-6,400, depending on available resources and the presence of competition (Costea and Tardif, 2005). Seeds can be dispersed by water, animals, and birds (Costea and Tardif, 2005). It has a persistent seed bank (Costea and Tardif, 2005).

It has a taproot (up to 70 cm in depth) with many lateral, secondary roots that are able to break the compacted ground and aerate the soil (Seiter, Farningham and Negret, 2019).

Current management: Mechanical control of this species is not effective and often needs to be combined with herbicide application (Costea and Tardif, 2005). Mulching favors its growth in Poland (Costea and Tardif, 2005).

Competitive ability: : Prostrate knotweed is quite stress tolerant and is frequently found in ruderal and disturbed habitats (Costea and Tardif, 2005). The plants in highly trampled areas rely on seed reproduction and tend to be much branched with smaller leaves (Costea and Tardif, 2005). It also has many genotypes that contribute to its tolerance to numerous habitats (Costea and Tardif, 2005).

Shade tolerance: It thrives in sun (Costea and Tardif, 2005).

Soil type: The plant adapts well in all types of soil and textures (Costea and Tardif, 2005). It tolerates dry, temporary water-logged, saline, calcareous, compacted, infertile and heavy metal pollutant soils (Costea and Tardif, 2005). It grows in soil PH from 5-8.4 (Costea and Tardif, 2005).

Community: It is often found associated with *Matricaria discoidea*, *Plantago major* and *Polygonum aviculare* in heavy traffic areas, due to their tolerance to the compacted and trampled soils. It was also found growing together with *Echinochloa crusgalli*, *Hordeum jubatum*, *Artemisia biennis* Willd and *Kochia scoparia* in agricultural fields (Costea and Tardif, 2005). In a trampled, disturbed area, it is more competitive than *Chenopodium album* and *Stellaria media* (Costea and Tardif, 2005). It can also discourage the growth and emergence of *Chenopodium album* (Costea and Tardif, 2005).

Functions:       



Figure 4.1.33

Purslane

Portulaca oleracea

Growth year: Annual (Miyanishi and Cavers, 1980)

Family: Portulacaceae (Miyanishi and Cavers, 1980)

Height: Up to 15 cm tall (Hilty, n.d.)

Origin and spread: It is possibly native in North America or introduced from South America or North Africa to be used as an ornamental plant (Dickinson, 1999, Miyanishi and Cavers, 1980).

Damage: Purslane is a common weed in both crop fields and garden, however it is not regarded as a competitive weed in agricultural fields in Manitoba (Manitoba Agriculture, n.d.). It might also be poisonous to livestock (Miyanishi and Cavers, 1980). It is a host for many pests and pathogens that may cause damage for crops (Miyanishi and Cavers, 1980).

Reproduction: Flowers are primarily self-pollinated, or occasionally cross-pollinated by wind, since there is no nectar in its flower and it is rarely visited by insects (Miyanishi and Cavers, 1980).

It propagates from both seeds and vegetative reproduction, however, it mainly relies on rapid seeds reproduction for its growth (Miyanishi and Cavers, 1980). Seeds can still be produced even when leaves and stems are removed from roots, due to their high water content (Miyanishi and Cavers, 1980). Also because it is a succulent species it can create a humid microclimate that could protect nearby species from drought (Blair, 2014). It produces up to 242,540 per plant and because there is no vector specialized for its seeds dispersal, seeds commonly fall beside parent plant (Miyanishi and Cavers, 1980). However, occasionally, animals and humans can still act as agents to disperse its seeds spread over long distance (Miyanishi and Cavers, 1980). The viability of its seeds is up to 40 years if buried in soil (Miyanishi and Cavers, 1980).

It has a strong tap root with many secondary fibrous roots that can form a dense mat up to 60 cm in diameter (Miyanishi and Cavers, 1980). Due to its stout taproot, it is able to break the compact ground and bring the nutrient up to the soil surface. (Blair, 2014) Moreover, the broken part of stem left in soil can give rise to adventitious roots, thereby forming a new plant (Miyanishi and Cavers, 1980).

Current management: Cultivation and hand pulling can be used to control its spread (Miyanishi and Cavers, 1980). However, the whole plant must be removed as it can continue setting seeds and giving rise to new plant by its roots and stem fragments (Miyanishi and Cavers, 1980).

Competitive ability: Purslane is considered an early successional plant that tends to be the first species to occupy open and disturbed ground (Blair, 2014). It is not that competitive with taller vegetation. It has self-thinning effect, and its population is governed internally (Miyanishi and Cavers, 1980).

Shade tolerance: It thrives in full sun and can be susceptible to shade (Hilty, n.d; Miyanishi and Cavers, 1980)

Soil type: It prefers mesic to dry rich conditions and adapts well in loam, sand, gravel, calcareous and acidity soils (Hilty, n.d; Miyanishi and Cavers, 1980).

Functions: 

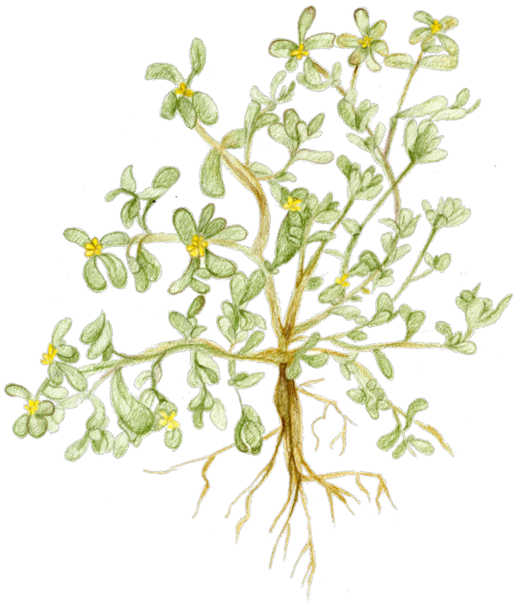


Figure 4.1.34

Silvery cinquefoil

Potentilla argentea

Growth year: Perennial (OMAFRA, 2000b)

Family: Rosaceae (OMAFRA, 2000b)

Height: 10-50 cm (OMAFRA, 2000b)

Origin and spread: Silver cinquefoil was introduced to North America from Europe (Go Botany, n.d.).

Damage: It is a common weed in highly managed area, such as turf and garden.

Reproduction: The species is reproduced only by seed production (OMAFRA, 2000).

Current management: Digging out this plant by hand or with tools can be used to eradicate this species (Roth, 2002).

Competitive ability: It is not as aggressive as other weeds.

Shade tolerance: It prefers full sun, and tolerates light shade (Missouri Botanical Garden, n.d.).

Soil type: The plant grows best in dry to moderate moist, well-drained, infertile and compacted soils (Del Tredici, 2010; Missouri Botanical Garden, n.d.).

Functions: 



Figure 4.1.35

Rough cinquefoil

Potentilla norvegica

Growth year: Annual, biennial or short-lived perennial (Hilty, n.d)

Family: Rosaceae (Hilty, n.d)

Height: 30-60 cm (Hilty, n.d)

Origin and spread: It is considered either as an introduced species imported from Eurasia, or a native species (Hilty, n.d).

Damage: It is often regarded as a lawn weed by people.

Reproduction: It propagates only by seed production (Hilty, n.d). The plant produces up to 13,000 seeds (Dickinson and Royer, 2014). The viability of seeds is up to 20 years (Dickinson and Royer, 2014). Animals play as important agents for its dispersal, as its seeds are still viable after going through the digestive tracts (Hilty, n.d).

It has a shallow branching taproot (Hilty, n.d).

Current management: Mowing before flowering can be effective for its control (karen, 2014). Cultivation for several seasons and digging out the entire plant can also be adopted for its control (karen, 2014).

Competitive ability: It Is frequently found in disturbed habitats (Hilty, n.d). It is not that competitive compared with other perennial species, as its seedlings may easily be crowded out (Bebeau, 2013). It is not that aggressive compared with other weeds.

Shade tolerance: It thrives in full and partial sun (Hilty, n.d).

Soil type: Rough cinquefoil grows well in moderate dry to moist conditions, fertile and poor soils, including loam , clay-loam, sandy loam, and rocky soils (Hilty, n.d).

Functions: 



Figure 4.1.36

Curly dock

Rumex crispus

Growth year: Perennial (Hilty, n.d.)

Family: Polygonaceae (Hilty, n.d.)

Height: 40-120 cm (CABI, n.d.)

Origin and spread: Curly dock was introduced to North America from Europe (Hilty, n.d.).

Damage: It is a common weed in agricultural fields, especially for perennial crops and pastures (CABI, n.d.). Its seeds can also cause impurity in cereal seeds (Manitoba Agriculture, n.d.). Curly dock can also be poisonous to poultry (Dickinson and Royer, 2014). It is also a host for several pathogens that can cause damage to crops (Dickinson and Royer, 2014))

Reproduction: It has perfect and female flowers on the same plant (Hilty, n.d.). It is cross-pollinated by wind (Hilty, n.d.).

The species is reproduced only by seeds (CABI, n.d.). Each plant can produce up to 60,000 seeds (Dickinson and Royer, 2014). The viability of seeds is more than 50 years, so it can develop a persistent seed bank (CABI, n.d.; Hilty, n.d.). Seeds can be dispersed by wind, water, animals and birds, as they are still viable in droppings (CABI, n.d.).

It has a strong deep taproot that enables the plant to tolerate drought (CABI, n.d.; Hilty, n.d.). Even a piece of root left in the ground may continue to grow (Roth, 2002).

Current management: Frequently mowing of its young species can benefit its growth, as it would develop more prostrate leaves that can avoid being cut in the future (CABI, n.d.). In comparison, in an area that is less cut, the leaves tend to be erect and once cut, its biomass can be hugely removed (CABI, n.d.). Digging out the entire plant and cutting the stems before its flowering can also be adopted for its control (CABI, n.d.; Roth, 2002).

Competitive ability: It adapts well in disturbed areas (Hilty, n.d.). The disturbance of soil can also stimulate its seeds germination (CABI, n.d.; Hilty, n.d.). However, it can also adapt well in the ground that is less disturbed, and it grows well with other perennial plants in grasslands and meadows(CABI, n.d.). Nevertheless, it never poses a threat to a well-established community (Minnesota Wildflowers, n.d.).

Shade tolerance: Curly dock thrives in full sun (Hilty, n.d.).

Soil type: The plant prefers moist to dry conditions and grows well in many types of soil, including loam, clay-loam and gravel (Hilty, n.d.). It tolerates drought and temporary water-logged areas as well as infertile soils (Hilty, n.d.). It does not tolerate to the acid soil and can be quite competitive in fertile soils (CABI, n.d.).

Functions:     



Figure 4.1.37

Common groundsel

Senecio vulgaris

Growth year: Summer or winter annual (Robinson, et al, 2003)

Family: Caryophyllaceae (Hilty, n.d)

Height: 10-60cm (Robinson, et al, 2003)

Origin and spread: It was introduced from Eurasia to North America and was widely distributed across Canada (Robinson, et al, 2003).

Damage: Common groundsel is a common weed in agricultural fields, gardens and lawns, due to its fecundity (Robinson, et al, 2003). It is resistant to numerous herbicides, which makes it hard to be controlled in flower, fruit and vegetable crops (Robinson, et al, 2003). The pyrrolizidine alkaloids it contains are poisonous to livestock (Robinson, et al, 2003).

Reproduction: It is self incompatible and is primarily cross-pollinated by insects (Robinson, et al, 2003).

The plant is reproduced only by seed (Robinson, et al, 2003). The mean number of seeds it produced is 38,300 (Robinson, et al, 2003). The pappus attached on seeds enable the wind for it to spread a long distance (Robinson, et al, 2003). Seeds can also be spread by water, digestive tracts of animals and human agencies (Robinson, et al, 2003).

Common goundsel has a taproot (Robinson, et al, 2003).

Current management: Tilling to the depths of 10 to 14 cm in fall or spring would reduce its germination, as the seeds would become dormant when buried deeply in soils (Robinson, et al, 2003).

Competitive ability: It is a ruderal species that frequently occupies the disturbed or degraded ground (Robinson, et al, 2003). It has self-thinning effect when growing in a higher density cluster as less seeds produced due to intraspecific competition, reducing its competition ability with its neighbors (Robinson, et al, 2003). In a heavily weeded habitat, it is characterized by rapid growth, short lifespan, longer flowering time, continuous seed production and emergence (Robinson, et al, 2003).

Shade tolerance: It thrives in full to partial sun, but it can tolerate light shade (Del Tredici, 1945, Hilty, n.d). The light level influences its morphology, while its branches are much spreader and shorter with smaller leaves in open area, its stems becomes taller and thicker with bigger leaves in shady area.

Soil type: It adapts to a wide range of soil types and nutrition levels, but poor soil would discourage its growth on ground and reduce its seeds production (Robinson, et al, 2003). It prefers moist, rich loam or clay-loam (Hilty, n.d). Common groundsel tolerates temporary flooding (Hilty, n.d). It has also been found to tolerate saline soils, acid rain and the ground contaminated by lead.

Community: The species is found to be associated with *Chenopodium album*, *Ambrosia artemisiifolia*, *Plantago major*, *Taraxacum officinale*, *Elymus repens* in Southern Ontario. Dead leaves of *Poa annua* would inhibit the growth of Common groundsel.

Functions:   



Figure 4.1.38

Green foxtail

Setaria viridis

Growth year: Annual (Douglas, et al, 1984)

Family: Poaceae (Douglas, et al, 1984)

Height: 10-100 cm (Douglas, et al, 1984)

Origin and spread: Green foxtail was introduced to North America from Europe either for its forage value or accidentally keeping company with ship ballasts (Douglas, et al, 1984; Seiter and Future Green Studio, 2016). It is widely distributed in Canada, especially in the West (Douglas, et al, 1984).

Damage: It is a common weed in crop fields, due to its rapid growth rate to form flowers, prolific seed production and phenotypic plasticity (Douglas, et al, 1984).

Reproduction: Flowers are primarily cross-pollinated by wind, but agamospermy has been reported (Douglas, et al, 1984).

It is reproduced only by seeds (Douglas, et al, 1984). It produces around 34,000 seeds per plant (Manitoba Agriculture, n.d.). Seeds can be dispersed by animals when setae on the spikelet attached to the fur of animals, though it is also spread by birds and by water (Douglas, et al, 1984). Normally, the viability of it seeds is 3 years while there are records that it can still be viable for thirty years when buried in soil (Douglas, et al, 1984).

Green foxtail has shallow fibrous roots with many branches (Kaulbars, 2000).

Current management: The plant can be controlled if sown with other dense and strong vegetations (Manitoba Agriculture, n.d.). A coverage by mulch and soil cultivation can kill its seedlings (Gift, 2011).

Competitive ability: It is a ruderal species frequently colonizing bare and disturbed ground, but rarely entering well-established communities (Seiter, Farningham and Negret, 2019). It can be quite competitive for nitrogen in soil (Douglas, et al, 1984). However, it is a poor competitor in a growing sward, unless growing in a dense population (Douglas, et al, 1984).

Shade tolerance: The species thrives in full sun (Manitoba Agriculture, n.d.). Shade would inhibit the growth of this species (Douglas, et al, 1984).

Soil type: In Manitoba, it adapts well to all types of soil texture (Douglas, et al, 1984). It prefers fertile soil than infertile (Douglas, et al, 1984). It tolerates saline soil (Del Tredici, 1945). However, it doesn't adapt to cool and dry conditions (Manitoba Agriculture, n.d.).

Community: It was found associated with *Cirsium arvense*, *Sonchus arvensis*, *Amaranthus retroflexus*, *Chenopodium album*, *Elymus repens*, *Echinochloa crusgalli* and *Kochia scoparia* in fields in Manitoba (Douglas, et al, 1984).

Functions:      



Figure 4.1.39

Perennial sow thistle

Sonchus arvensis

Growth year: Perennial (Lemna and Messersmith, 1990)

Family: Asteraceae (Lemna and Messersmith, 1990)

Height: 60-150cm (Lemna and Messersmith, 1990)

Origin and spread: It was likely introduced to North America from Europe or Asia as a seed contaminant (Lemna and Messersmith, 1990). Currently, it is widely spread to all Canada provinces (Lemna and Messersmith, 1990).

Damage: Perennial sow thistle is a common weed for field crops, horticultural crops and forages (Manitoba Agriculture, n.d.). It is also a host for some pests and parasites which may pose a threat to crops (Lemna and Messersmith, 1990).

Reproduction: It has perfect flowers but generally self-sterile, so it relies on insects for cross-pollination (Lemna and Messersmith, 1990).

Even though it mainly relies on vegetative reproduction from spreading roots, it can also reproduce by seed (Lemna and Messersmith, 1990).

The species can produce up to 4,000 seeds per plant (Lemna and Messersmith, 1990). Wind is a primary vector for seeds dispersal as there are bristles on achenes (Lemna and Messersmith, 1990). Bristles also enable animals and humans to spread the seeds once attached on them (Lemna and Messersmith, 1990).

A large patch of perennial sow thistle can be formed by the vegetative reproduction of a single plant (Lemna and Messersmith, 1990). When the stolon touch the ground and root in soil, ramets come into being, which later would form independent plants as lateral roots broken apart (Lemna and Messersmith, 1990). Moreover, spreading roots can develop up to 150 cm long, while vertical roots can spread more than 50 cm long (Lemna and Messersmith, 1990).

Current management: Tillage is more effective than simply mowing (Lemna and Messersmith, 1990). There is less chance for regrowth if buried deeper in the soil (Lemna and Messersmith, 1990).

Competitive ability: Although Perennial sow thistle is quite reproductive, it is an early successional plant on recently disturbed sites (Lemna and Messersmith, 1990). Other species such as *Artemisia sp.*, *Crepis sp.*, and grasses will outcompete it in the following years (Lemna and Messersmith, 1990).

Shade tolerance: Perennial sow thistle prefers full sun (Hilty, n.d.).

Soil type: It grows well in moist to dry conditions, rich loamy soils (Hilty, n.d., Lemna and Messersmith, 1990). It also adapts to moderate saline soil (Lemna and Messersmith, 1990).

Community: It was associated with *Symphyotrichum ericoides* and *Hordeum jubatum* near saline depressions in Saskatchewan (Lemna and Messersmith, 1990). It also grew together with *Kochia scoparia* in dry saline areas in three prairie provinces (Lemna and Messersmith, 1990). Perennial sow thistle was also found growing with *Elymus repens*, *Cirsium arvense* and *Taraxacum officinale* in an Alfalfa seeded area in Manitoba (Lemna and Messersmith, 1990).

Functions:





Figure 4.1.40

Common chickweed

Stellaria media

Growth year: Annual or winter annual (Turkington, et al, 1980)

Family: Caryophyllaceae (Turkington, et al, 1980)

Height: 5-40 cm (Turkington, et al, 1980)

Origin and spread: Common chickweed was introduced from Europe to North America for an unknown reason (Turkington, et al, 1980). It is found throughout Canada, but is more prevalent on the east and west coasts (Turkington, et al, 1980).

Damage: It is a common weed in agricultural fields (Turkington, et al, 1980). Its seeds can cause seed impurity for some crops (Turkington, et al, 1980). When grazed by sheep and goats, it may give rise to digestive disorders (Turkington, et al, 1980). It is also a host for some pathogens and pests that may cause damage to crops (Turkington, et al, 1980). Due to its shade tolerance, it can compete well with some crops (Manitoba Agriculture, n.d.).

Reproduction: Common chickweed is primarily self-pollinated, though cross-pollinated may occasionally be observed (Turkington, et al, 1980).

It is reproduced by both seeds and creeping stolons (Manitoba Agriculture, n.d.).

Seeds produced per plant ranges from 500 to 2,500 and can be dispersed by animals, human agencies and wind (Turkington, et al, 1980). The viability of its seeds is up to 60 years if buried deeply in soil (Turkington, et al, 1980).

The roots are fibrous (Turkington, et al, 1980). And the species can root at the nodes on creeping stems under certain circumstance (Turkington, et al, 1980).

Current management: Mowing would reduce seed production (Turkington, et al, 1980). Mulching and digging out the entire plant can also be helpful to reduce the growth of this species (Gift, 2011; Orlando, 2018).

Competitive ability: Common chickweed is a pioneer species that can quickly occupy the open spaces and would soon be crowded out in a growing community (Turkington, et al, 1980). However, there are conditions that dense clumps of chickweed could inhibit the growth of seedlings for other species (Turkington, et al, 1980).

Shade tolerance: It grows well in full to partial sun and tolerates to light shade (Hilty, n.d.).

Soil type: Common chickweed adapts well in moist to mesic levels, rich loam and clay-loam soils (Hilty, n.d.). It is susceptible to drought condition (Turkington, et al, 1980).

Community: It was found associated with *Matricaria discoidea*, *Senecio vulgaris*, *Amaranthus retroflexus*, *Chenopodium album*, *Capsella bursa-pastoris*, *Elymus repens* and *Poa annua* in Canada (Turkington, et al, 1980).

Functions:





Figure 4.1.41

Lindley’s aster

Symphotrichum ciliolatum

Growth year: Perennial (The Manitoba Museum, 2014)

Family: Asteraceae (The Manitoba Museum, 2014)

Height: 20-100 cm (The Manitoba Museum, 2014)

Origin and spread: Lindley's aster is a native species and widely spread across Canada (The Manitoba Museum, 2014).

Damage: It is regarded as a weed in lawn.

Reproduction: There are white hairs attached on seeds that help it to be dispersed by wind.

Competitive ability: It is a ruderal species that often colonize disturbed and open habitat (Minnesota Wildflowers, n.d.). It does not have any invasive threats and grows quite well in the prairie climate. However, in recent years, it has appeared in lawns in the City of Winnipeg.

Shade tolerance: Lindley's' aster thrives in full sun (The Manitoba Museum, 2014).

Soil type: The plant prefers mesic to dry condition and sand soils (The Manitoba Museum, 2014). It tolerates drought conditions (The Manitoba Museum, 2014).

Functions:   



Figure 4.1.42

Heath aster

Symphotrichum ericoides

Growth year: Perennial (Chmielewski and Semple, 2003)

Family: Asteraceae (Chmielewski and Semple, 2003)

Height: 40-90 cm (Chmielewski and Semple, 2003)

Origin and spread: Heath aster is a native and an important species in the tall grass prairie. It is distributed widely across Canada (Chmielewski and Semple, 2003).

Damage: Heath aster may reduce yields in pasture land (Chmielewski and Semple, 2003). It may also be poisonous to livestock, as it can accumulate selenium if grown in seleniferous soils (Chmielewski and Semple, 2003).

Reproduction: The plant is self-incompatible and cross-pollinated by insects (Chmielewski and Semple, 2003).

It is reproduced by both seeds and rhizomes (Chmielewski and Semple, 2003). It can produce a large number of seeds (Chmielewski and Semple, 2003). The pappus attached on achenes makes it possible to be dispersed long distances by wind (Chmielewski and Semple, 2003).

The nodes on the stolons that developed from the buds at the base of caudices can give rise to a new plant (Chmielewski and Semple, 2003).

Current management: Heath aster tolerates light to moderate mowing (Chmielewski and Semple, 2003). While early mowing can be used for its maintenance, cutting in its growth season can benefit its growth to a large extent (Chmielewski and Semple, 2003).

Competitive ability: Heath aster is a ruderal species that often colonizes disturbed and open habitat (Chmielewski and Semple, 2003). It won't survive under trees and shrub cover (Chmielewski and Semple, 2003). However, it can be a strong competitor for prairie grasses and often shows up in prairie remnants (Chmielewski and Semple, 2003).

Shade tolerance: It thrives in full sun and can be susceptible to shade (Chmielewski and Semple, 2003).

Soil type: The plant prefers mesic conditions and is often found in well-drained sand and gravel soils (Chmielewski and Semple, 2003). On the prairies, it grows well in moist to slightly dry soils (Chmielewski and Semple, 2003). The species tolerates high saline, alkaline and dry soils, yet it grows much better in fertile soil (Chmielewski and Semple, 2003).

Community: It was found associated with *Chenopodium album* during the drought period (Chmielewski and Semple, 2003).

Functions:   



Figure 4.1.43

Dandelion

Taraxacum officinale

Growth year: Perennial (Stewart-Wade, et al, 2002)

Family: Asteraceae (Stewart-Wade, et al, 2002)

Height: 30-45 cm (Hilty, n.d.)

Origin and spread: Dandelion was either introduced from Europe to North America by the Vikings via Beringia at the post Pleistocene period, or was imported by Europeans for its ornamental and medicinal values in 1600s (Stewart-Wade, et al, 2002).

Damage: It is a prevalent weed in crop fields and turf (Stewart-Wade, et al, 2002). It is also a host for many pests that may cause damage to onions (Stewart-Wade, et al, 2002). The pollen of the Dandelion is an allergen to some individuals (Stewart-Wade, et al, 2002).

Reproduction: Though it has perfect flowers, the seeds of the dandelion are produced without fertilization (Stewart-Wade, et al, 2002). However, due to its multiple genotype and phenotypic plasticity, it is able to survive in many habitats (Stewart-Wade, et al, 2002).

The dandelion is reproduced by both seeds and vegetative reproduction (Stewart-Wade, et al, 2002).

The amount of seeds can be up to 23,436 per plant (Stewart-Wade, et al, 2002). There are pappus developed on seeds for wind dispersal, the distance of which is approximately 200-500m (Stewart-Wade, et al, 2002). The distance dispersed would also increase as the wind velocity increases (Stewart-Wade, et al, 2002). Seeds can also be moved around through the digestive tract of animals or by floating in water (Stewart-Wade, et al, 2002). Some seeds are viable after being buried in soil for 9 years (Stewart-Wade, et al, 2002).

The species has a deep taproot (up to 1-2 m long) that can break the compacted soil, aerate soil and bring nutrients up to the ground (Stewart-Wade, et al, 2002). It also has numerous lateral roots (Stewart-Wade, et al, 2002). Even a fragment of root left on ground would give rise to a new plant (Stewart-Wade, et al, 2002).

Current management: Current management includes increasing fertilizer application, selecting more competitive turf species and mowing as well as pulling (Stewart-Wade, et al, 2002). However, even the number of viable seeds would decrease if cutting in flowering stage; it is not that effective in controlling its dispersal and survival, which is due to the regenerative ability of its long taproot, and the shift of shoot-root ratio (Stewart-Wade, et al, 2002).

Competitive ability: It can be a both colonizer in open space and an inhabitant for a closed grass sward (Stewart-Wade, et al, 2002). Due to its intolerance of shade, it is not that competitive with tall plants (Stewart-Wade, et al, 2002). However, due to its phenotypic plasticity, the leaves on rosette would become more erect when grown with taller vegetation, thereby helping it survive with competition (Stewart-Wade, et al, 2002). It can also release allelopathic chemicals that would inhibit growth of its neighboring plants (Stewart-Wade, et al, 2002).

Shade tolerance: Dandelion is susceptible to shade (Stewart-Wade, et al, 2002).

Soil type: It prefers mesic level, loam and clay-loam soils (Hilty, n.d.); The increasing nitrogen fertilizer in soil would inhibit the growth of Dandelion (Stewart-Wade, et al, 2002).

Functions:





Figure 4.1.44

Red clover

Trifolium pratense

Growth year: Perennial (Hilty, n.d.)

Family: Fabaceae(Hilty, n.d.)

Height: 15-60 cm (Hilty, n.d.)

Origin and spread: Red clover was imported from Eurasia to North America for its forage value (Hilty, n.d.)

Damage: It is often regarded as a weed in highly managed areas such as lawns and gardens.

Reproduction: It is reproduced by both seeds and underground rhizomes (Hilty, n.d.).

Red clover has a taproot that can break up the compacted soil and aerate the ground Del Tredici, 2010). It also has creeping rootlets that can give rise to a new plant at the nodes (Hilty, n.d.).

Current management: It does not tolerate mowing in comparison to White clover (Hilty, n.d.).

Competitive ability: Red clover prefers disturbed and ruderal habitats. It is not that aggressive in native and grassy communities (Hilty, n.d.).

Shade tolerance: It thrives in full sun, and partial sun is also tolerated (Hilty, n.d.).

Soil type: Red clover grows well in mesic condition, loam or clay-loam soils. (Hilty, n.d.)

Functions:





Figure 4.1.45

White clover

Trifolium repens

Growth year: Perennial (Turkington and Burdon, 1983)

Family: Fabaceae (Turkington and Burdon, 1983)

Height: Up to 50 cm (Turkington and Burdon, 1983)

Origin and spread: White clover was introduced from Europe to North America to be used as a forage crop (Turkington and Burdon, 1983). Currently, it has spread widely in Canada (Turkington and Burdon, 1983).

Damage: White clover is regarded as a weed in highly managed areas, such as lawns and gardens, due to its fecundity (Turkington and Burdon, 1983).

Reproduction: Flowers mainly rely on insects for cross-pollination, though self-pollination reported (Turkington and Burdon, 1983).

It is reproduced by both seeds and spreading stolons (Turkington and Burdon, 1983). There is no special morphology developed for its seeds dispersal, but it can occasionally be distributed by animals or humans (Turkington and Burdon, 1983).

It has many stolons developed from buds on stems (Turkington and Burdon, 1983). Each stolon may develop a shallow taproot (generally around 10cm) from its nodes and later become independent from the parent plant, thereby resulting in a new plant (Turkington and Burdon, 1983).

Current management: White clover tolerates mowing (Del Tredici, 1945). Removing flowers won't discourage the vegetative growth of White clover, but when flowering, the growth of the stolon would cease, because the development of both the stolon and flowers relies on the same bud (Turkington and Burdon, 1983). However, digging out the entire plant can be used for its control (Roth, 2002)

Competitive ability: The drier climate and higher temperatures during summer in the prairies may restrict the growth of White clover due to its shallow roots (Turkington and Burdon, 1983). It is not a pioneer species and would only enter a community when the fertile level increases (Turkington and Burdon, 1983). Due to its intolerance of shade, it is not that competitive in tall vegetative communities and mainly relies on vegetative reproduction in such condition, such as in grasslands and pastures, and rarely shows up in forests (Turkington and Burdon, 1983). It relies on seed reproduction when moving into new habitat (Turkington and Burdon, 1983).

Shade tolerance: It prefers full sun and doesn't tolerate shades. (Del Tredici, 1945)

Soil type: White clover prefers mesic condition and tolerates a wide range of soil types, but often occurs on loam and clay soil (Del Tredici, 1945; Hilty, n.d.; Turkington and Burdon, 1983). It does not tolerates salt (Turkington and Burdon, 1983).

Community: It was found associated with *Elymus repens* and *Trifolium repens* in a pasture (Turkington and Burdon, 1983).

Functions:





Figure 4.1.46

Bird vetch

Vicia cracca

Growth year: Perennial (Aarssen, Hall and Jensen, 1986)

Family: Fabaceae

Height: The winding stem is up to 2 m long (Aarssen, Hall and Jensen, 1986)

Origin and spread: Bird vetch was originally introduced from Europe to North America as fodder (Aarssen, Hall and Jensen, 1986). It is most prevalent in Eastern Canada as well as on the west coast (Aarssen, Hall and Jensen, 1986).

Damage: Bird vetch is a common weed for many crops such as cereals, forages, fruit trees and berries (Aarssen, Hall and Jensen, 1986). It is also a host to some pests and pathogens which may cause damage to these crops (Aarssen, Hall and Jensen, 1986).

Reproduction: Flowers can be cross-pollinated by insects (Aarssen, Hall and Jensen, 1986).

It reproduces by both seeds and an underground creeping root system (Aarssen, Hall and Jensen, 1986). It can produce up to 500 seeds per plant (Dickinson, 1999). The seeds can be dispersed by wildlife if feeding on them (Aarssen, Hall and Jensen, 1986).

Tendrils on stems enable the species to attach and twine on vertical elements (Aarssen, Hall and Jensen, 1986).

Current management: Mowing before Bird vetch sets seeds can exhaust the plant (Aarssen, Hall and Jensen, 1986).

Shade tolerance: The plant prefers full to partial sun habitats (Aarssen, Hall and Jensen, 1986).

Soil type: It often occurs in sand or gravel soils (Aarssen, Hall and Jensen, 1986).

Community: *Elymus repens*, *Medicago lupulina*, *Medicago sativa*, *Poa pratensis*, *Taraxacum officinale*, *Trifolium pretense* were found associated with Bird vetch in a pasture in Kingston, Ontario (Aarssen, Hall and Jensen, 1986).

Functions:





Figure 4.1.47

Conclusion

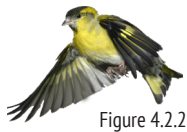
By understanding the habit and the basic knowledge of these most popular 47 ‘weeds’ in the City of Winnipeg, there is a hope that residents can better recognize or even create their own ways to manage these species in their lawn.

4.2. Four proposed usages for ‘Weeds’ in Winnipeg

In an attempt to let residents in the City of Winnipeg to better appreciate the value of ‘weeds’ I cross-referenced and illustrate four major benefactors for these ‘weeds’. In this way, citizens can learn how to utilize the ‘weeds’ and appreciate them in their life.



Pollinator support



Songbirds support



Foraging value



Soil remediation



Pollinator support

This section records pollinators, including bees, butterflies and flies that are reported visiting the flowers of these 47 ‘weeds,’ along with their flowering times. As these insects are also reported showing up in Manitoba, it’s more likely these ‘weeds’ will offer a food source for these pollinators during the flowering months in the city. This chapter also records which ‘weeds’ can play as host species for the caterpillars of butterflies because to support a butterfly, both host and nectar plants are needed.

By revealing the values of these weeds and linking them to a specific insect, I hope the residents in the city could get a better understanding of these ‘nuisance’ plants, thereby appreciating them.

Due to the limitation of data and sources, along with their importance as a pollinator, different kinds of pollinators are classified to different taxonomy levels.

For the bee section, I separate the bees as long-tongued bees and short-tongued bees. Whether or not the length of

bee tongues matches the depth of certain flowers influences their ability to collect pollen and feeding on nectar (Ecological Society of America, 2014). Whereas the long-tongued bees is classified as tribes, the short-tongued bees are listed as subfamily.

The butterflies are listed as species because they enjoy the high ornamental value and is more likely to be accepted by residents to create a butterfly garden.

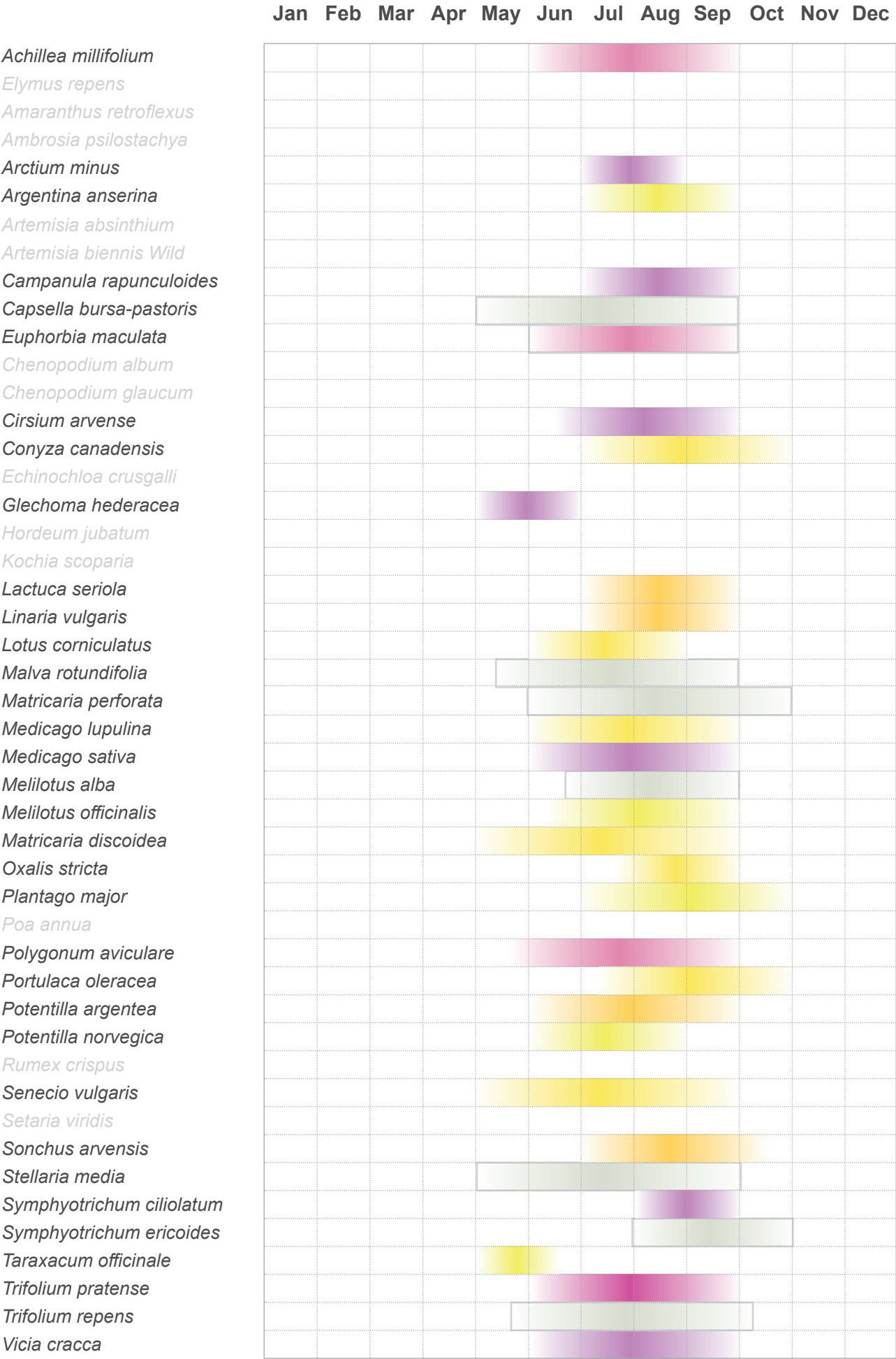
The flies are listed as family, as they are less important pollinators.

Legend:

-  Flowers visiting
-  Leaves visiting

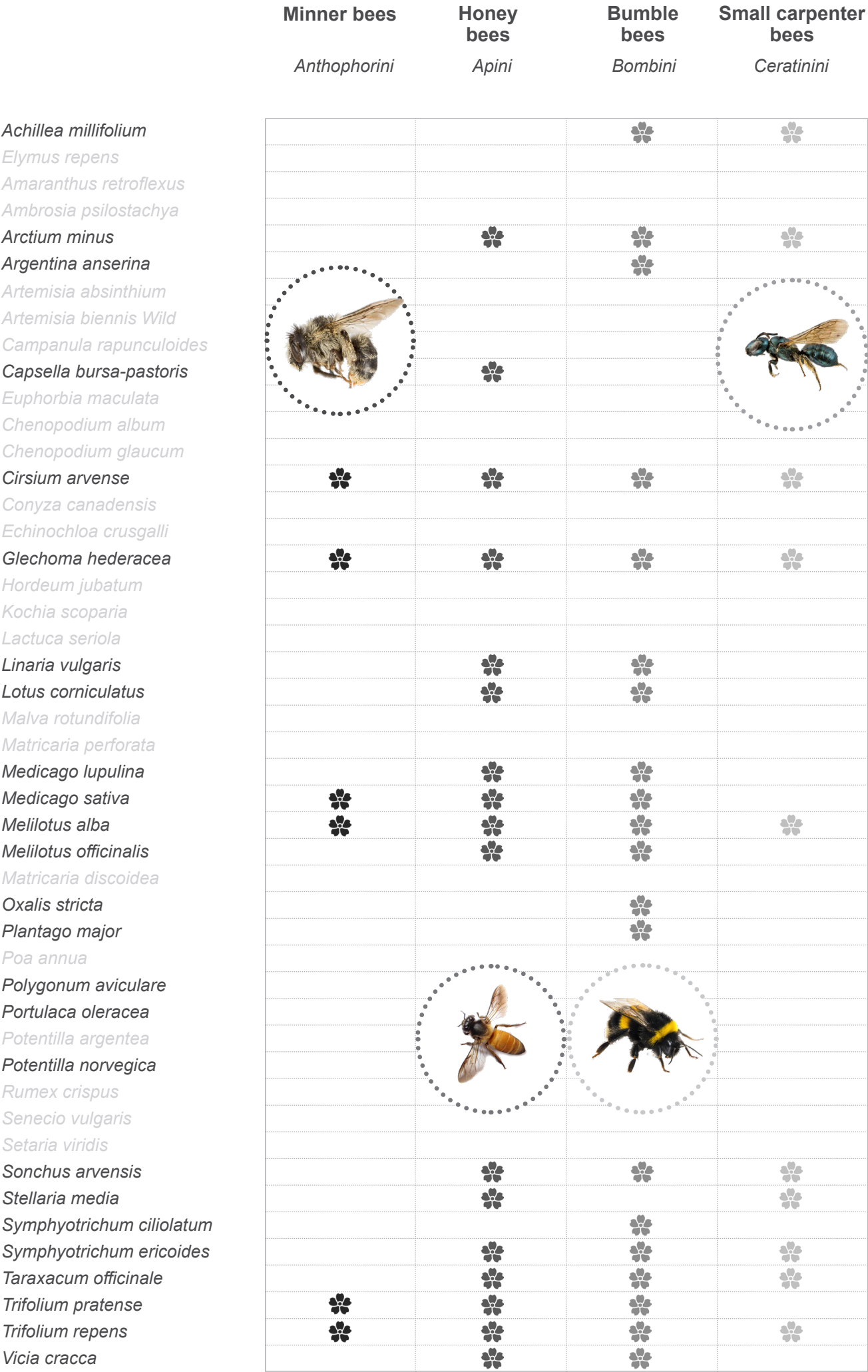
Flowering time

Figure 4.2.6



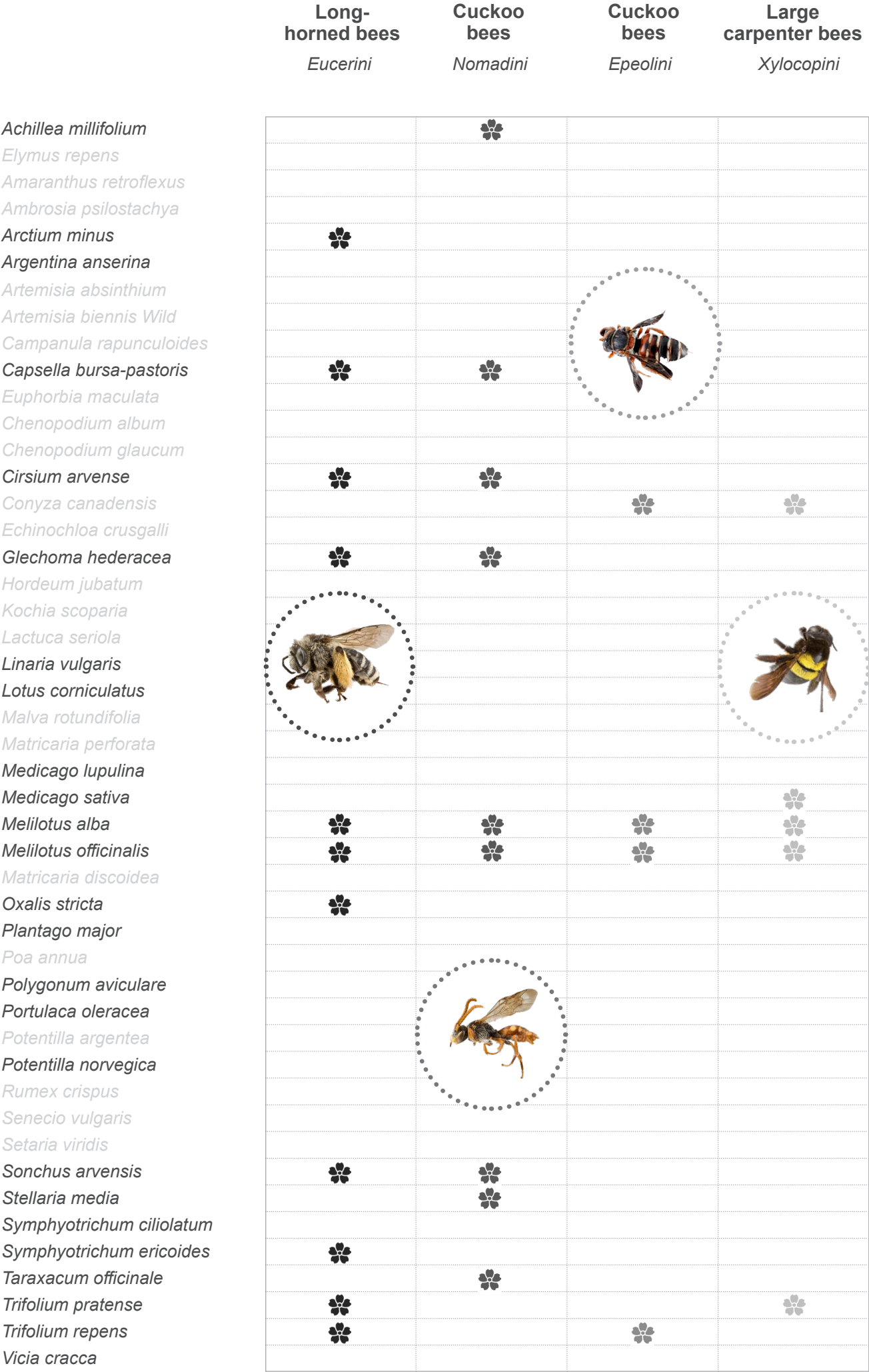
Long-tongued Bees

Figure 4.2.7



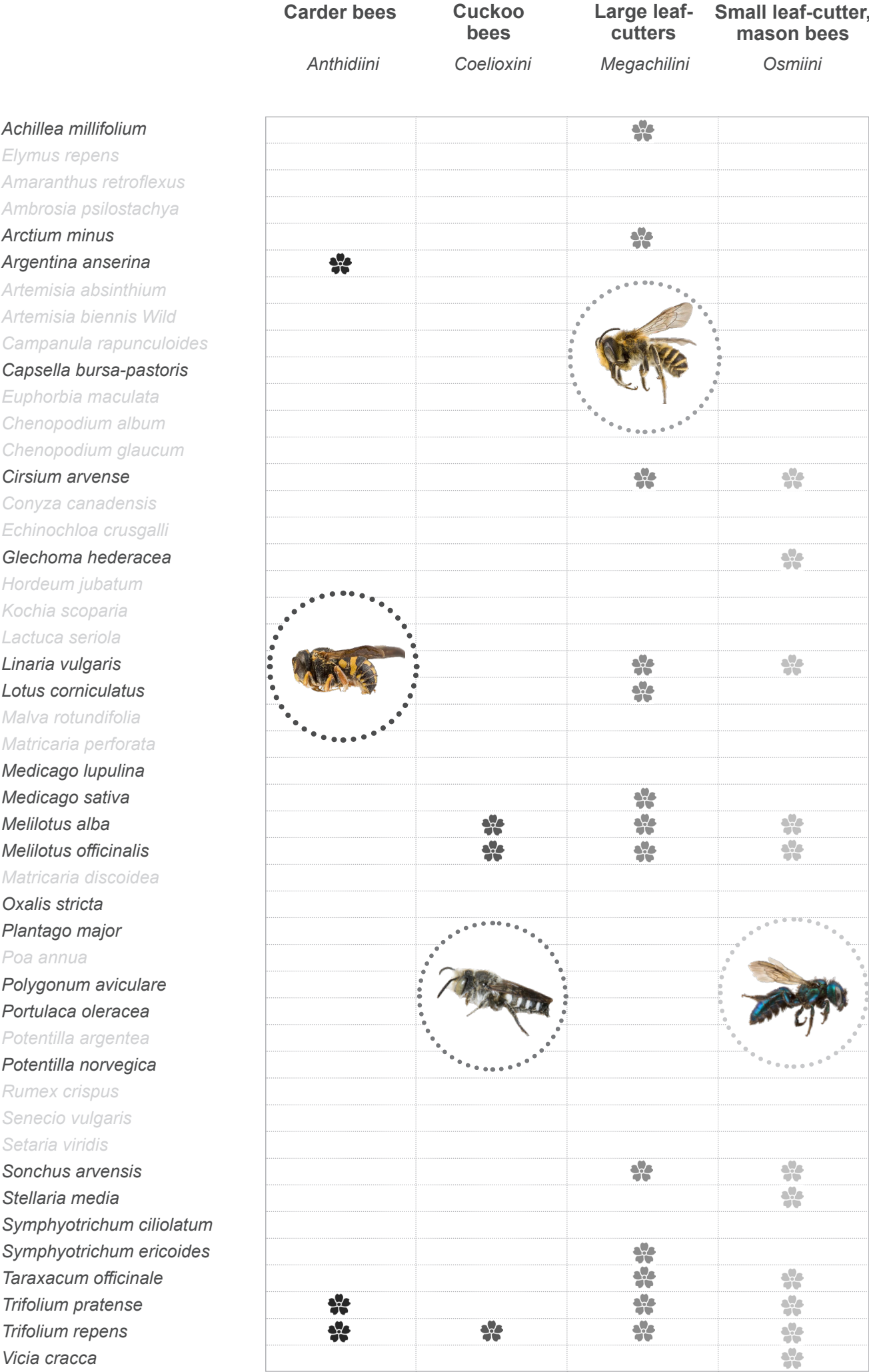
Long-tongued Bees

Figure 4.2.7



Long-tongued Bees

Figure 4.2.7



Long-tongued Bees

Leaf-cutters

Trypetini

- Achillea millifolium
- Elymus repens
- Amaranthus retroflexus
- Ambrosia psilostachya
- Arctium minus
- Argentina anserina
- Artemisia absinthium
- Artemisia biennis Wild
- Campanula rapunculoides
- Capsella bursa-pastoris
- Euphorbia maculata
- Chenopodium album
- Chenopodium glaucum
- Cirsium arvense
- Conyza canadensis
- Echinochloa crusgalli
- Glechoma hederacea
- Hordeum jubatum
- Kochia scoparia
- Lactuca seriola
- Linaria vulgaris
- Lotus corniculatus
- Malva rotundifolia
- Matricaria perforata
- Medicago lupulina
- Medicago sativa
- Melilotus alba
- Melilotus officinalis
- Matricaria discoidea
- Oxalis stricta
- Plantago major
- Poa annua
- Polygonum aviculare
- Portulaca oleracea
- Potentilla argentea
- Potentilla norvegica
- Rumex crispus
- Senecio vulgaris
- Setaria viridis
- Sonchus arvensis
- Stellaria media
- Symphyotrichum ciliolatum
- Symphyotrichum ericoides
- Taraxacum officinale
- Trifolium pratense
- Trifolium repens
- Vicia cracca

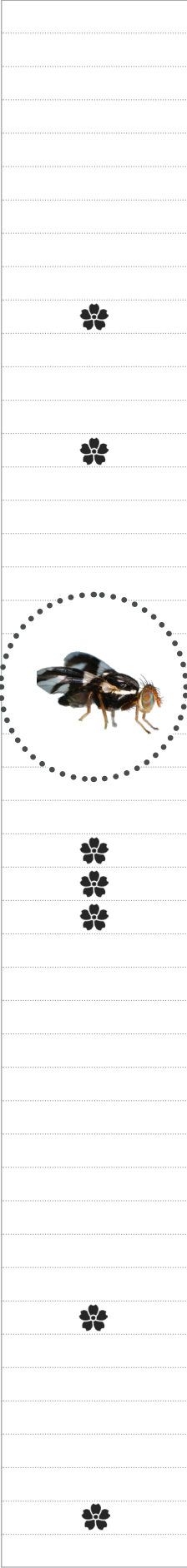


Figure 4.2.7

Short-tongued Bees

- Small miner bees
Andreninae
- Dagger bees
Panurginae
- Plasterer bees, miner bees
Colletinae
- Masked bees
Hylaeinae

- Achillea millifolium
- Elymus repens
- Amaranthus retroflexus
- Ambrosia psilostachya
- Arctium minus
- Argentina anserina
- Artemisia absinthium
- Artemisia biennis Wild
- Campanula rapunculoides
- Capsella bursa-pastoris
- Euphorbia maculata
- Chenopodium album
- Chenopodium glaucum
- Cirsium arvense
- Conyza canadensis
- Echinochloa crusgalli
- Glechoma hederacea
- Hordeum jubatum
- Kochia scoparia
- Lactuca seriola
- Linaria vulgaris
- Lotus corniculatus
- Malva rotundifolia
- Matricaria perforata
- Medicago lupulina
- Medicago sativa
- Melilotus alba
- Melilotus officinalis
- Matricaria discoidea
- Oxalis stricta
- Plantago major
- Poa annua
- Polygonum aviculare
- Portulaca oleracea
- Potentilla argentea
- Potentilla norvegica
- Rumex crispus
- Senecio vulgaris
- Setaria viridis
- Sonchus arvensis
- Stellaria media
- Symphyotrichum ciliolatum
- Symphyotrichum ericoides
- Taraxacum officinale
- Trifolium pratense
- Trifolium repens
- Vicia cracca



Figure 4.2.8

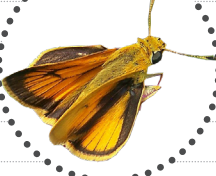
Short-tongued Bees

Figure 4.2.8

Alkali bees	Halictine bees
Nomiinae	Halictinae
<i>Achillea millifolium</i>	
<i>Elymus repens</i>	
<i>Amaranthus retroflexus</i>	
<i>Ambrosia psilostachya</i>	
<i>Arctium minus</i>	
<i>Argentina anserina</i>	
<i>Artemisia absinthium</i>	
<i>Artemisia biennis</i> Wild	
<i>Campanula rapunculoides</i>	
<i>Capsella bursa-pastoris</i>	
<i>Euphorbia maculata</i>	
<i>Chenopodium album</i>	
<i>Chenopodium glaucum</i>	
<i>Cirsium arvense</i>	
<i>Conyza canadensis</i>	
<i>Echinochloa crusgalli</i>	
<i>Glechoma hederacea</i>	
<i>Hordeum jubatum</i>	
<i>Kochia scoparia</i>	
<i>Lactuca seriola</i>	
<i>Linaria vulgaris</i>	
<i>Lotus corniculatus</i>	
<i>Malva rotundifolia</i>	
<i>Matricaria perforata</i>	
<i>Medicago lupulina</i>	
 	 
<i>Melilotus alba</i>	
<i>Melilotus officinalis</i>	
<i>Matricaria discoidea</i>	
<i>Oxalis stricta</i>	
<i>Plantago major</i>	
<i>Poa annua</i>	
	
<i>Polygonum aviculare</i>	
<i>Portulaca oleracea</i>	
<i>Potentilla argentea</i>	
<i>Potentilla norvegica</i>	
<i>Rumex crispus</i>	
<i>Senecio vulgaris</i>	
<i>Setaria viridis</i>	
<i>Sonchus arvensis</i>	
<i>Stellaria media</i>	
<i>Symphotrichum ciliolatum</i>	
<i>Symphotrichum ericoides</i>	
<i>Taraxacum officinale</i>	
<i>Trifolium pratense</i>	
<i>Trifolium repens</i>	
<i>Vicia cracca</i>	

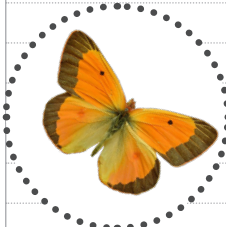
Butterflies

Figure 4.2.9

Delaware skipper	Least skipper	Common wood-nymph	Silvery checkerspot
<i>Anatrytone logan</i>	<i>Ancyloxpha numitor</i>	<i>Cercyonis pegala</i>	<i>Chlosyne nycteis</i>
<i>Achillea millifolium</i>			
<i>Elymus repens</i>			
<i>Amaranthus retroflexus</i>			
<i>Ambrosia psilostachya</i>			
<i>Arctium minus</i>			
<i>Argentina anserina</i>			
<i>Artemisia absinthium</i>			
<i>Artemisia biennis</i> Wild			
<i>Campanula rapunculoides</i>			
<i>Capsella bursa-pastoris</i>			
<i>Euphorbia maculata</i>			
<i>Chenopodium album</i>			
<i>Chenopodium glaucum</i>			
<i>Cirsium arvense</i>			
<i>Conyza canadensis</i>			
<i>Echinochloa crusgalli</i>			
<i>Glechoma hederacea</i>			
<i>Hordeum jubatum</i>			
<i>Kochia scoparia</i>			
<i>Lactuca seriola</i>			
<i>Linaria vulgaris</i>			
<i>Lotus corniculatus</i>			
<i>Malva rotundifolia</i>			
<i>Matricaria perforata</i>			
<i>Medicago lupulina</i>			
<i>Medicago sativa</i>			 
<i>Melilotus alba</i>			
<i>Melilotus officinalis</i>			
<i>Matricaria discoidea</i>			
<i>Oxalis stricta</i>			
<i>Plantago major</i>			
<i>Poa annua</i>			
			
<i>Polygonum aviculare</i>			
<i>Portulaca oleracea</i>			
<i>Potentilla argentea</i>			
<i>Potentilla norvegica</i>			
<i>Rumex crispus</i>			
<i>Senecio vulgaris</i>			
<i>Setaria viridis</i>			
<i>Sonchus arvensis</i>			
<i>Stellaria media</i>			
<i>Symphotrichum ciliolatum</i>			
<i>Symphotrichum ericoides</i>			
<i>Taraxacum officinale</i>			
<i>Trifolium pratense</i>			
<i>Trifolium repens</i>			
<i>Vicia cracca</i>			

Butterflies

Figure 4.2.9

	Orange sulphur <i>Colias eurytheme</i>	Common sulphur <i>Colias philodice</i>	Monarch <i>Danaus plexippus</i>	Eastern tailed Blue <i>Everes comyntas</i>
<i>Achillea millifolium</i>				
<i>Elymus repens</i>				
<i>Amaranthus retroflexus</i>				
<i>Ambrosia psilostachya</i>				
<i>Arctium minus</i>				
<i>Argentina anserina</i>				
<i>Artemisia absinthium</i>				
<i>Artemisia biennis</i> Wild				
<i>Campanula rapunculoides</i>				
<i>Capsella bursa-pastoris</i>				
<i>Euphorbia maculata</i>				
<i>Chenopodium album</i>				
<i>Chenopodium glaucum</i>				
<i>Cirsium arvense</i>				
<i>Conyza canadensis</i>				
<i>Echinochloa crusgalli</i>				
<i>Glechoma hederacea</i>				
<i>Hordeum jubatum</i>				
<i>Kochia scoparia</i>				
<i>Lactuca seriola</i>				
<i>Linaria vulgaris</i>				
<i>Lotus corniculatus</i>				
<i>Malva rotundifolia</i>				
<i>Matricaria perforata</i>				
<i>Medicago lupulina</i>				
<i>Medicago sativa</i>				
<i>Melilotus alba</i>				
<i>Melilotus officinalis</i>				
<i>Matricaria discoidea</i>				
<i>Oxalis stricta</i>				
<i>Plantago major</i>				
<i>Poa annua</i>				
<i>Polygonum aviculare</i>				
<i>Portulaca oleracea</i>				
<i>Potentilla argentea</i>				
<i>Potentilla norvegica</i>				
<i>Rumex crispus</i>				
<i>Senecio vulgaris</i>				
<i>Setaria viridis</i>				
<i>Sonchus arvensis</i>				
<i>Stellaria media</i>				
<i>Symphyotrichum ciliolatum</i>				
<i>Symphyotrichum ericoides</i>				
<i>Taraxacum officinale</i>				
<i>Trifolium pratense</i>				
<i>Trifolium repens</i>				
<i>Vicia cracca</i>				

Butterflies

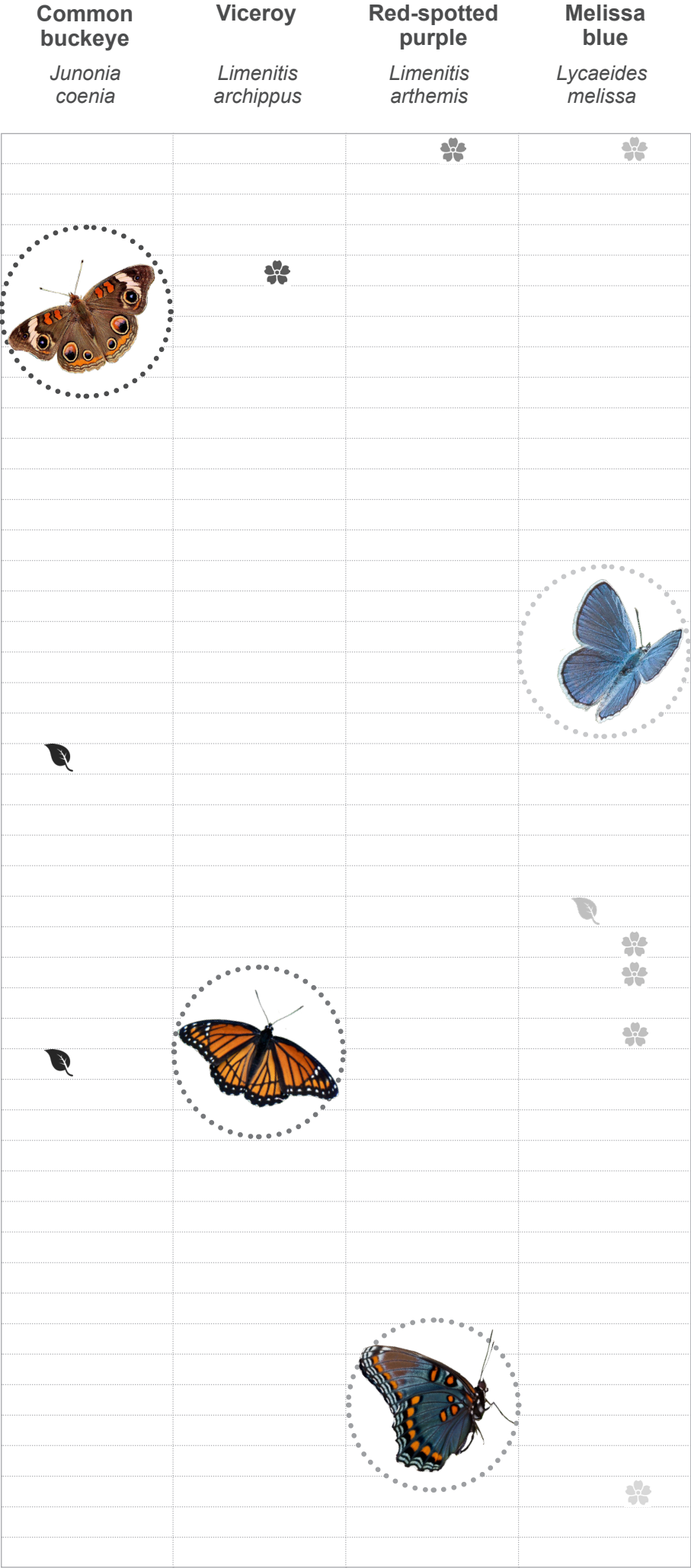
Figure 4.2.9

	Baltimore checkerspots <i>Euphydryas phaeton</i>	Variegated fritillary <i>Euptoieta claudia</i>	Little yellow <i>Eurema lisa</i>	Silvery blue <i>Glaucopsyche lygdamus</i>
<i>Achillea millifolium</i>				
<i>Elymus repens</i>				
<i>Amaranthus retroflexus</i>				
<i>Ambrosia psilostachya</i>				
<i>Arctium minus</i>				
<i>Argentina anserina</i>				
<i>Artemisia absinthium</i>				
<i>Artemisia biennis</i> Wild				
<i>Campanula rapunculoides</i>				
<i>Capsella bursa-pastoris</i>				
<i>Euphorbia maculata</i>				
<i>Chenopodium album</i>				
<i>Chenopodium glaucum</i>				
<i>Cirsium arvense</i>				
<i>Conyza canadensis</i>				
<i>Echinochloa crusgalli</i>				
<i>Glechoma hederacea</i>				
<i>Hordeum jubatum</i>				
<i>Kochia scoparia</i>				
<i>Lactuca seriola</i>				
<i>Linaria vulgaris</i>				
<i>Lotus corniculatus</i>				
<i>Malva rotundifolia</i>				
<i>Matricaria perforata</i>				
<i>Medicago lupulina</i>				
<i>Medicago sativa</i>				
<i>Melilotus alba</i>				
<i>Melilotus officinalis</i>				
<i>Matricaria discoidea</i>				
<i>Oxalis stricta</i>				
<i>Plantago major</i>				
<i>Poa annua</i>				
<i>Polygonum aviculare</i>				
<i>Portulaca oleracea</i>				
<i>Potentilla argentea</i>				
<i>Potentilla norvegica</i>				
<i>Rumex crispus</i>				
<i>Senecio vulgaris</i>				
<i>Setaria viridis</i>				
<i>Sonchus arvensis</i>				
<i>Stellaria media</i>				
<i>Symphotrichum ciliolatum</i>				
<i>Symphotrichum ericoides</i>				
<i>Taraxacum officinale</i>				
<i>Trifolium pratense</i>				
<i>Trifolium repens</i>				
<i>Vicia cracca</i>				

Butterflies

Figure 4.2.9

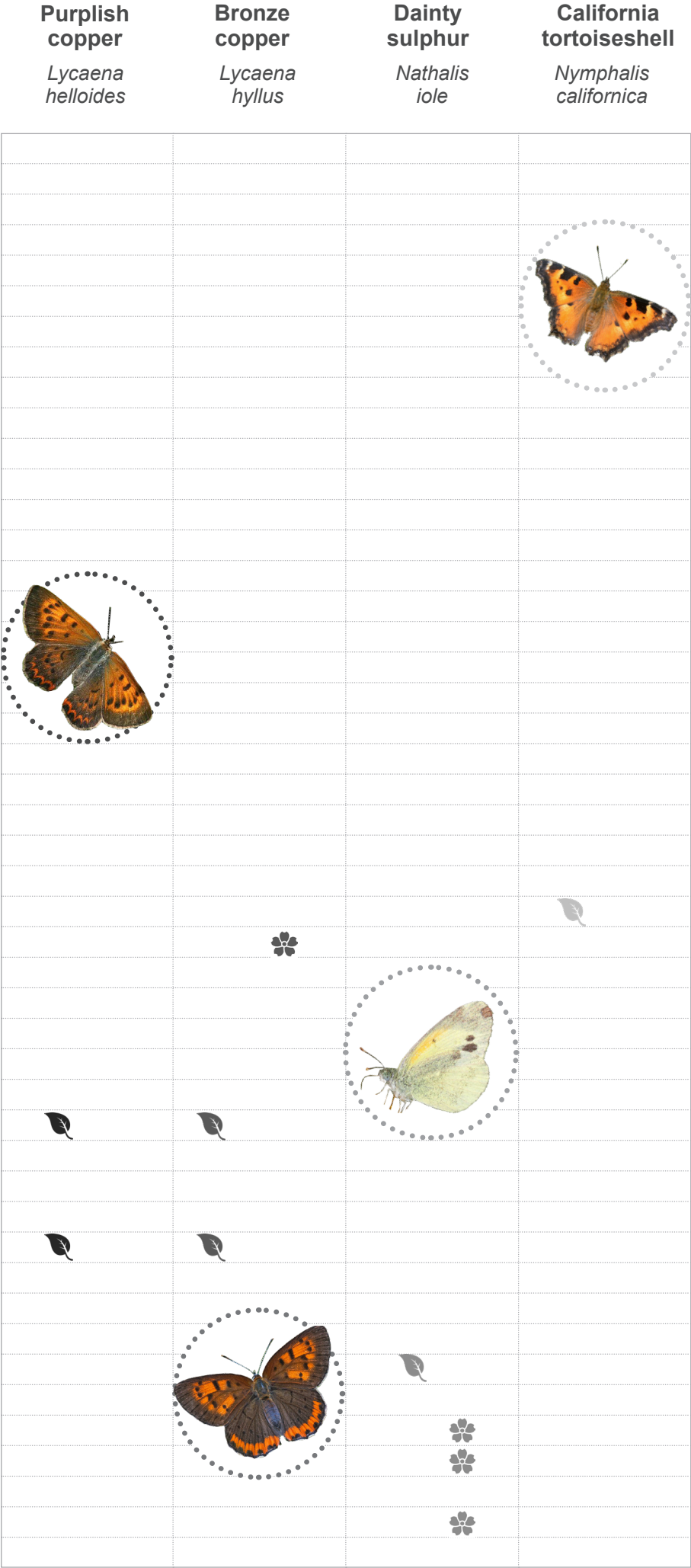
Achillea millifolium
Elymus repens
Amaranthus retroflexus
Ambrosia psilostachya
Arctium minus
Argentina anserina
Artemisia absinthium
Artemisia biennis Wild
Campanula rapunculoides
Capsella bursa-pastoris
Euphorbia maculata
Chenopodium album
Chenopodium glaucum
Cirsium arvense
Conyza canadensis
Echinochloa crusgalli
Glechoma hederacea
Hordeum jubatum
Kochia scoparia
Lactuca seriola
Linaria vulgaris
Lotus corniculatus
Malva rotundifolia
Matricaria perforata
Medicago lupulina
Medicago sativa
Melilotus alba
Melilotus officinalis
Matricaria discoidea
Oxalis stricta
Plantago major
Poa annua
Polygonum aviculare
Portulaca oleracea
Potentilla argentea
Potentilla norvegica
Rumex crispus
Senecio vulgaris
Setaria viridis
Sonchus arvensis
Stellaria media
Symphotrichum ciliolatum
Symphotrichum ericoides
Taraxacum officinale
Trifolium pratense
Trifolium repens
Vicia cracca



Butterflies

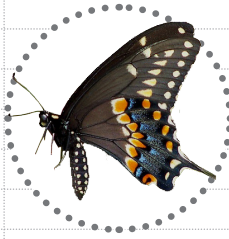
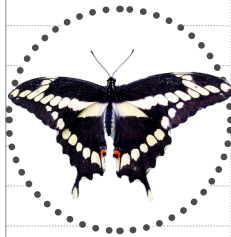
Figure 4.2.9

Achillea millifolium
Elymus repens
Amaranthus retroflexus
Ambrosia psilostachya
Arctium minus
Argentina anserina
Artemisia absinthium
Artemisia biennis Wild
Campanula rapunculoides
Capsella bursa-pastoris
Euphorbia maculata
Chenopodium album
Chenopodium glaucum
Cirsium arvense
Conyza canadensis
Echinochloa crusgalli
Glechoma hederacea
Hordeum jubatum
Kochia scoparia
Lactuca seriola
Linaria vulgaris
Lotus corniculatus
Malva rotundifolia
Matricaria perforata
Medicago lupulina
Medicago sativa
Melilotus alba
Melilotus officinalis
Matricaria discoidea
Oxalis stricta
Plantago major
Poa annua
Polygonum aviculare
Portulaca oleracea
Potentilla argentea
Potentilla norvegica
Rumex crispus
Senecio vulgaris
Setaria viridis
Sonchus arvensis
Stellaria media
Symphotrichum ciliolatum
Symphotrichum ericoides
Taraxacum officinale
Trifolium pratense
Trifolium repens
Vicia cracca



Butterflies

Figure 4.2.9

	Giant swallowtail <i>Papilio cressphontes</i>	Black swallowtail <i>Papilio polyxenes</i>	Pearl crescent <i>Phyciodes tharos</i>	Greenish blue <i>Plebejus saepiolus</i>
<i>Achillea millifolium</i>				
<i>Elymus repens</i>				
<i>Amaranthus retroflexus</i>				
<i>Ambrosia psilostachya</i>				
<i>Arctium minus</i>				
<i>Argentina anserina</i>				
<i>Artemisia absinthium</i>				
<i>Artemisia biennis</i> Wild				
<i>Campanula rapunculoides</i>				
<i>Capsella bursa-pastoris</i>				
<i>Euphorbia maculata</i>				
<i>Chenopodium album</i>				
<i>Chenopodium glaucum</i>				
<i>Cirsium arvense</i>				
<i>Conyza canadensis</i>				
<i>Echinochloa crusgalli</i>				
<i>Glechoma hederacea</i>				
<i>Hordeum jubatum</i>				
<i>Kochia scoparia</i>				
<i>Lactuca seriola</i>				
<i>Linaria vulgaris</i>				
<i>Lotus corniculatus</i>				
<i>Malva rotundifolia</i>				
<i>Matricaria perforata</i>				
<i>Medicago lupulina</i>				
<i>Medicago sativa</i>				
<i>Melilotus alba</i>				
<i>Melilotus officinalis</i>				
<i>Matricaria discoidea</i>				
<i>Oxalis stricta</i>				
<i>Plantago major</i>				
<i>Poa annua</i>				
<i>Polygonum aviculare</i>				
<i>Portulaca oleracea</i>				
<i>Potentilla argentea</i>				
<i>Potentilla norvegica</i>				
<i>Rumex crispus</i>				
<i>Senecio vulgaris</i>				
<i>Setaria viridis</i>				
<i>Sonchus arvensis</i>				
<i>Stellaria media</i>				
<i>Symphyotrichum ciliolatum</i>				
<i>Symphyotrichum ericoides</i>				
<i>Taraxacum officinale</i>				
<i>Trifolium pratense</i>				
<i>Trifolium repens</i>				
<i>Vicia cracca</i>				

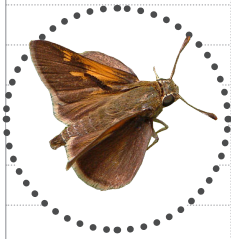
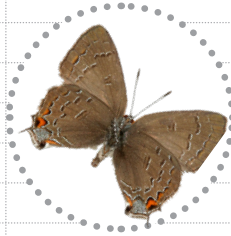
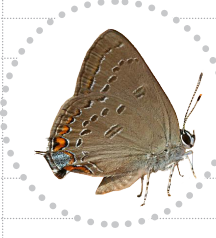
Butterflies

Figure 4.2.9

	Checkered white <i>Pieris protodice</i>	Cabbage white <i>Pieris rapae</i>	Hobomok skipper <i>Poanes hobomok</i>	Dash skipper <i>Polites mystic</i>
<i>Achillea millifolium</i>				
<i>Elymus repens</i>				
<i>Amaranthus retroflexus</i>				
<i>Ambrosia psilostachya</i>				
<i>Arctium minus</i>				
<i>Argentina anserina</i>				
<i>Artemisia absinthium</i>				
<i>Artemisia biennis</i> Wild				
<i>Campanula rapunculoides</i>				
<i>Capsella bursa-pastoris</i>				
<i>Euphorbia maculata</i>				
<i>Chenopodium album</i>				
<i>Chenopodium glaucum</i>				
<i>Cirsium arvense</i>				
<i>Conyza canadensis</i>				
<i>Echinochloa crusgalli</i>				
<i>Glechoma hederacea</i>				
<i>Hordeum jubatum</i>				
<i>Kochia scoparia</i>				
<i>Lactuca seriola</i>				
<i>Linaria vulgaris</i>				
<i>Lotus corniculatus</i>				
<i>Malva rotundifolia</i>				
<i>Matricaria perforata</i>				
<i>Medicago lupulina</i>				
<i>Medicago sativa</i>				
<i>Melilotus alba</i>				
<i>Melilotus officinalis</i>				
<i>Matricaria discoidea</i>				
<i>Oxalis stricta</i>				
<i>Plantago major</i>				
<i>Poa annua</i>				
<i>Polygonum aviculare</i>				
<i>Portulaca oleracea</i>				
<i>Potentilla argentea</i>				
<i>Potentilla norvegica</i>				
<i>Rumex crispus</i>				
<i>Senecio vulgaris</i>				
<i>Setaria viridis</i>				
<i>Sonchus arvensis</i>				
<i>Stellaria media</i>				
<i>Symphyotrichum ciliolatum</i>				
<i>Symphyotrichum ericoides</i>				
<i>Taraxacum officinale</i>				
<i>Trifolium pratense</i>				
<i>Trifolium repens</i>				
<i>Vicia cracca</i>				

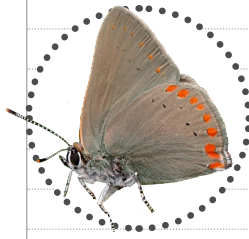
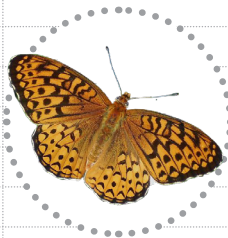
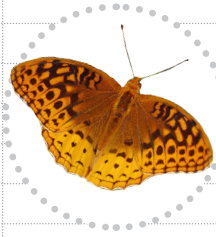
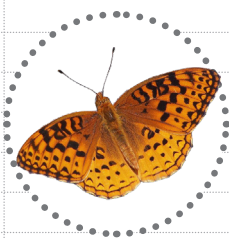
Butterflies

Figure 4.2.9

	Tawny-edged skipper	Common checkered-skipper	Banded hairstreak	Edwards' hairstreak
	<i>Polites themistocles</i>	<i>Pyrgus communis</i>	<i>Satyrrium calanus</i>	<i>Satyrrium edwardsii</i>
<i>Achillea millifolium</i>				
<i>Elymus repens</i>				
<i>Amaranthus retroflexus</i>				
<i>Ambrosia psilostachya</i>				
<i>Arctium minus</i>				
<i>Argentina anserina</i>				
<i>Artemisia absinthium</i>				
<i>Artemisia biennis</i> Wild				
<i>Campanula rapunculoides</i>				
<i>Capsella bursa-pastoris</i>				
<i>Euphorbia maculata</i>				
<i>Chenopodium album</i>				
<i>Chenopodium glaucum</i>				
<i>Cirsium arvense</i>				
<i>Conyza canadensis</i>				
<i>Echinochloa crusgalli</i>				
<i>Glechoma hederacea</i>				
<i>Hordeum jubatum</i>				
<i>Kochia scoparia</i>				
<i>Lactuca seriola</i>				
<i>Linaria vulgaris</i>				
<i>Lotus corniculatus</i>				
<i>Malva rotundifolia</i>				
<i>Matricaria perforata</i>				
<i>Medicago lupulina</i>				
<i>Medicago sativa</i>				
<i>Melilotus alba</i>				
<i>Melilotus officinalis</i>				
<i>Matricaria discoidea</i>				
<i>Oxalis stricta</i>				
<i>Plantago major</i>				
<i>Poa annua</i>				
<i>Polygonum aviculare</i>				
<i>Portulaca oleracea</i>				
<i>Potentilla argentea</i>				
<i>Potentilla norvegica</i>				
<i>Rumex crispus</i>				
<i>Senecio vulgaris</i>				
<i>Setaria viridis</i>				
<i>Sonchus arvensis</i>				
<i>Stellaria media</i>				
<i>Symphyotrichum ciliolatum</i>				
<i>Symphyotrichum ericoides</i>				
<i>Taraxacum officinale</i>				
<i>Trifolium pratense</i>				
<i>Trifolium repens</i>				
<i>Vicia cracca</i>				

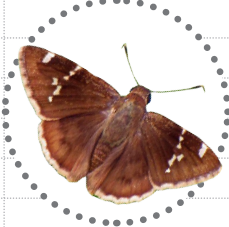
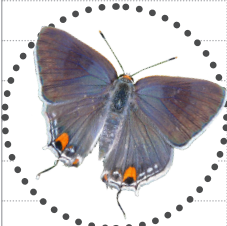
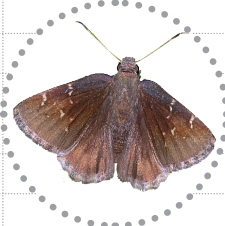
Butterflies

Figure 4.2.9

	Coral hairstreak	Aphrodite fritillary	Atlantis fritillary	Great spangled fritillary
	Satyrrium titus	Speyeria aphrodite	Speyeria atlantis	Speyeria cybele
Achillea millifolium				
Elymus repens				
Amaranthus retroflexus				
Ambrosia psilostachya				
Arctium minus				
Argentina anserina				
Artemisia absinthium				
Artemisia biennis Wild				
Campanula rapunculoides				
Capsella bursa-pastoris				
Euphorbia maculata				
Chenopodium album				
Chenopodium glaucum				
Cirsium arvense				
Conyza canadensis				
Echinochloa crusgalli				
Glechoma hederacea				
Hordeum jubatum				
Kochia scoparia				
Lactuca seriola				
Linaria vulgaris				
Lotus corniculatus				
Malva rotundifolia				
Matricaria perforata				
Medicago lupulina				
Medicago sativa				
Melilotus alba				
Melilotus officinalis				
Matricaria discoidea				
Oxalis stricta				
Plantago major				
Poa annua				
Polygonum aviculare				
Portulaca oleracea				
Potentilla argentea				
Potentilla norvegica				
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Senecio vulgaris				
Setaria viridis				
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Stellaria media				
Symphyotrichum ciliolatum				
Symphyotrichum ericoides				
Taraxacum officinale				
Trifolium pratense				
Trifolium repens				
Vicia cracca				

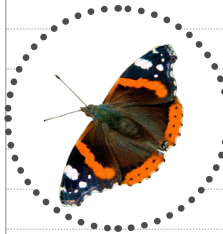
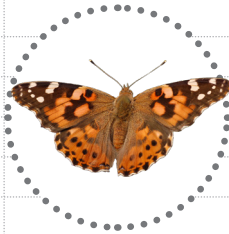
Butterflies

Figure 4.2.9

	Gray hairstreak	Southern cloudywing	Northern cloudywing	European skipper
	<i>Strymon melinus</i>	<i>Thorybes bathyllus</i>	<i>Thorybes pylades</i>	<i>Thymelicus lineola</i>
<i>Achillea millifolium</i>				
<i>Elymus repens</i>				
<i>Amaranthus retroflexus</i>				
<i>Ambrosia psilostachya</i>				
<i>Arctium minus</i>				
<i>Argentina anserina</i>				
<i>Artemisia absinthium</i>				
<i>Artemisia biennis</i> Wild				
<i>Campanula rapunculoides</i>				
<i>Capsella bursa-pastoris</i>				
<i>Euphorbia maculata</i>				
<i>Chenopodium album</i>				
<i>Chenopodium glaucum</i>				
<i>Cirsium arvense</i>				
<i>Conyza canadensis</i>				
<i>Echinochloa crusgalli</i>				
<i>Glechoma hederacea</i>				
<i>Hordeum jubatum</i>				
<i>Kochia scoparia</i>				
<i>Lactuca seriola</i>				
<i>Linaria vulgaris</i>				
<i>Lotus corniculatus</i>				
<i>Malva rotundifolia</i>				
<i>Matricaria perforata</i>				
<i>Medicago lupulina</i>				
<i>Medicago sativa</i>				
<i>Melilotus alba</i>				
<i>Melilotus officinalis</i>				
<i>Matricaria discoidea</i>				
<i>Oxalis stricta</i>				
<i>Plantago major</i>				
<i>Poa annua</i>				
<i>Polygonum aviculare</i>				
<i>Portulaca oleracea</i>				
<i>Potentilla argentea</i>				
<i>Potentilla norvegica</i>				
<i>Rumex crispus</i>				
<i>Senecio vulgaris</i>				
<i>Setaria viridis</i>				
<i>Sonchus arvensis</i>				
<i>Stellaria media</i>				
<i>Symphyotrichum ciliolatum</i>				
<i>Symphyotrichum ericoides</i>				
<i>Taraxacum officinale</i>				
<i>Trifolium pratense</i>				
<i>Trifolium repens</i>				
<i>Vicia cracca</i>				

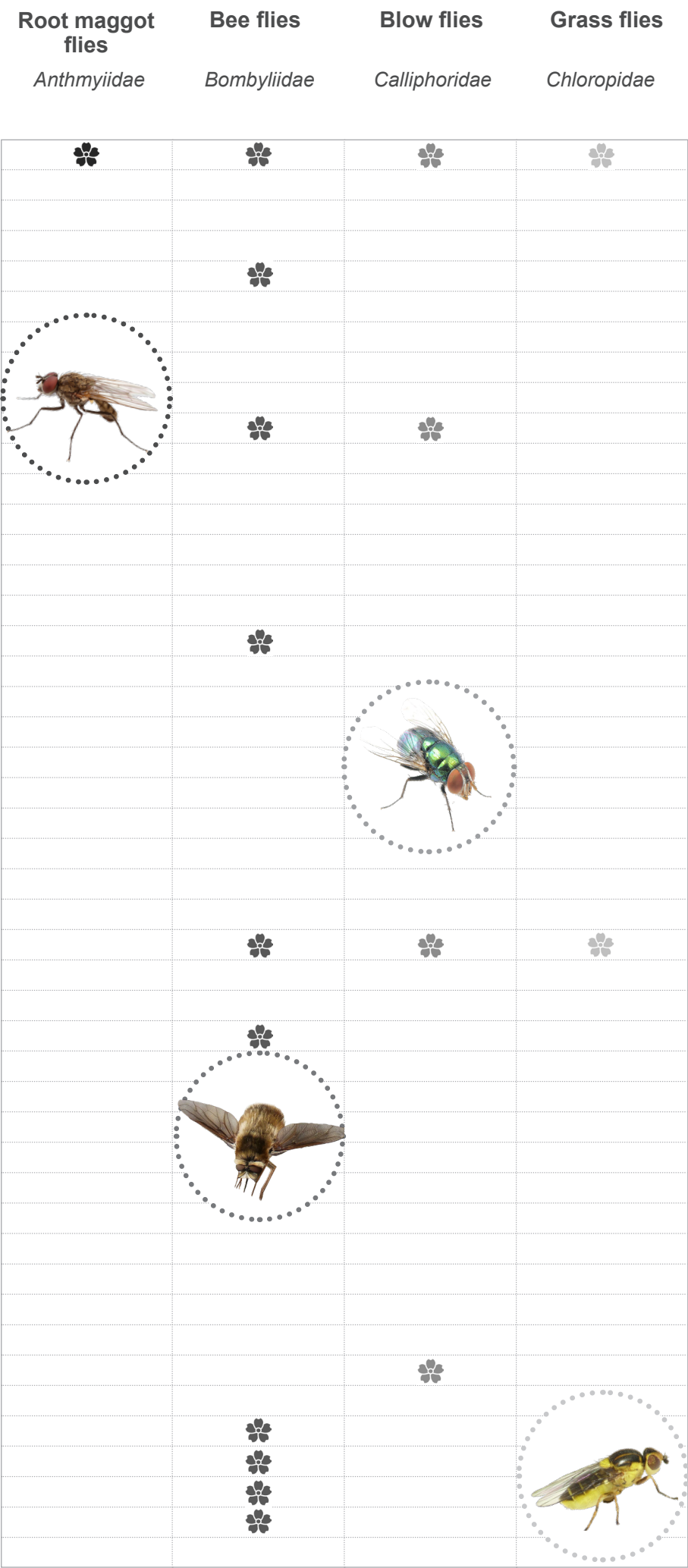
Butterflies

Figure 4.2.9

	Red admiral	Painted lady	American painted lady	Southern dogface
	<i>Vanessa atalanta</i>	<i>Vanessa cardui</i>	<i>Vanessa virginiensis</i>	<i>Zerene cesonia</i>
<i>Achillea millifolium</i>				
<i>Elymus repens</i>				
<i>Amaranthus retroflexus</i>				
<i>Ambrosia psilostachya</i>				
<i>Arctium minus</i>				
<i>Argentina anserina</i>				
<i>Artemisia absinthium</i>				
<i>Artemisia biennis</i> Wild				
<i>Campanula rapunculoides</i>				
<i>Capsella bursa-pastoris</i>				
<i>Euphorbia maculata</i>				
<i>Chenopodium album</i>				
<i>Chenopodium glaucum</i>				
<i>Cirsium arvense</i>				
<i>Conyza canadensis</i>				
<i>Echinochloa crusgalli</i>				
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<i>Hordeum jubatum</i>				
<i>Kochia scoparia</i>				
<i>Lactuca seriola</i>				
<i>Linaria vulgaris</i>				
<i>Lotus corniculatus</i>				
<i>Malva rotundifolia</i>				
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<i>Medicago lupulina</i>				
<i>Medicago sativa</i>				
<i>Melilotus alba</i>				
<i>Melilotus officinalis</i>				
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<i>Oxalis stricta</i>				
<i>Plantago major</i>				
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<i>Polygonum aviculare</i>				
<i>Portulaca oleracea</i>				
<i>Potentilla argentea</i>				
<i>Potentilla norvegica</i>				
<i>Rumex crispus</i>				
<i>Senecio vulgaris</i>				
<i>Setaria viridis</i>				
<i>Sonchus arvensis</i>				
<i>Stellaria media</i>				
<i>Symphotrichum ciliolatum</i>				
<i>Symphotrichum ericoides</i>				
<i>Taraxacum officinale</i>				
<i>Trifolium pratense</i>				
<i>Trifolium repens</i>				
<i>Vicia cracca</i>				

Flies

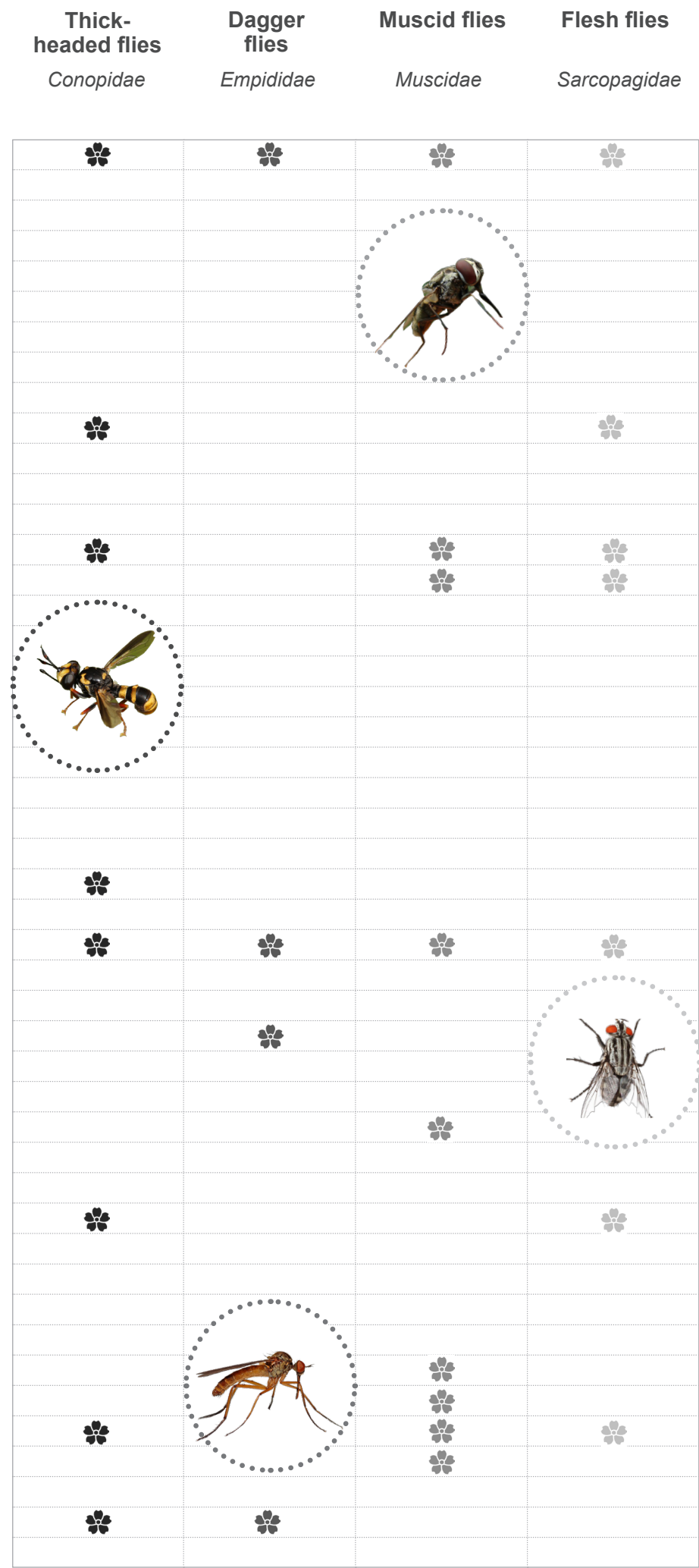
Figure 4.2.10



Achillea millifolium
Elymus repens
Amaranthus retroflexus
Ambrosia psilostachya
Arctium minus
Argentina anserina
Artemisia absinthium
Artemisia biennis Wild
Campanula rapunculoides
Capsella bursa-pastoris
Euphorbia maculata
Chenopodium album
Chenopodium glaucum
Cirsium arvense
Conyza canadensis
Echinochloa crusgalli
Glechoma hederacea
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Lactuca seriola
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Lotus corniculatus
Malva rotundifolia
Matricaria perforata
Medicago lupulina
Medicago sativa
Melilotus alba
Melilotus officinalis
Matricaria discoidea
Oxalis stricta
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Polygonum aviculare
Portulaca oleracea
Potentilla argentea
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Rumex crispus
Senecio vulgaris
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Sonchus arvensis
Stellaria media
Symphyotrichum ciliolatum
Symphyotrichum ericoides
Taraxacum officinale
Trifolium pratense
Trifolium repens
Vicia cracca

Flies

Figure 4.2.10



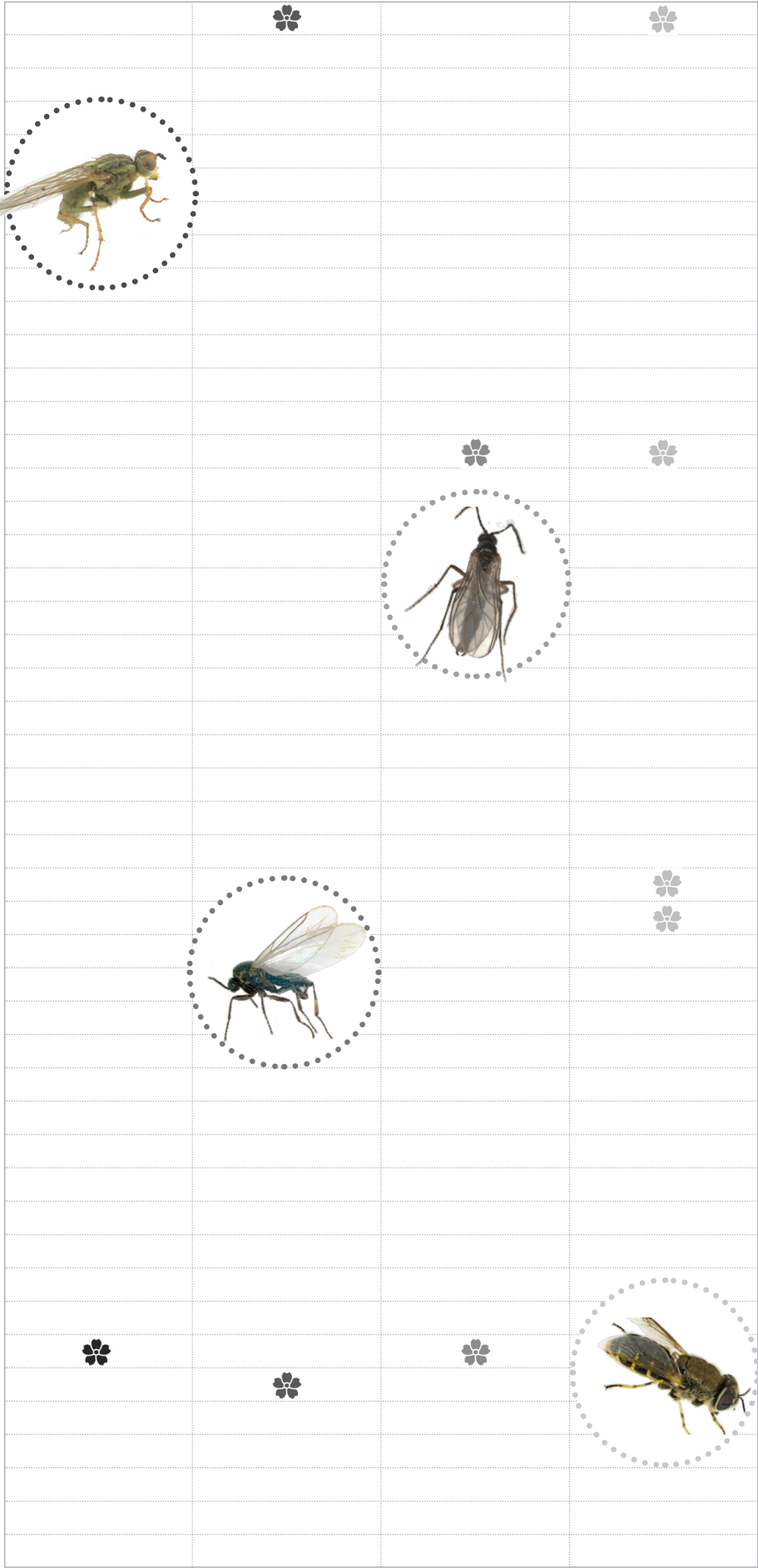
Achillea millifolium
Elymus repens
Amaranthus retroflexus
Ambrosia psilostachya
Arctium minus
Argentina anserina
Artemisia absinthium
Artemisia biennis Wild
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Symphyotrichum ciliolatum
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Trifolium repens
Vicia cracca

Flies

Figure 4.2.10

Achillea millifolium
Elymus repens
Amaranthus retroflexus
Ambrosia psilostachya
Arctium minus
Argentina anserina
Artemisia absinthium
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Stellaria media
Symphyotrichum ciliolatum
Symphyotrichum ericoides
Taraxacum officinale
Trifolium pratense
Trifolium repens
Vicia cracca

Scathophagid flies
Scathophagidae
Minute black scavenger flies
Scatopsidae
Dark-winged fungus gnats
Sciaridae
Soldier flies
Stratiomyidae

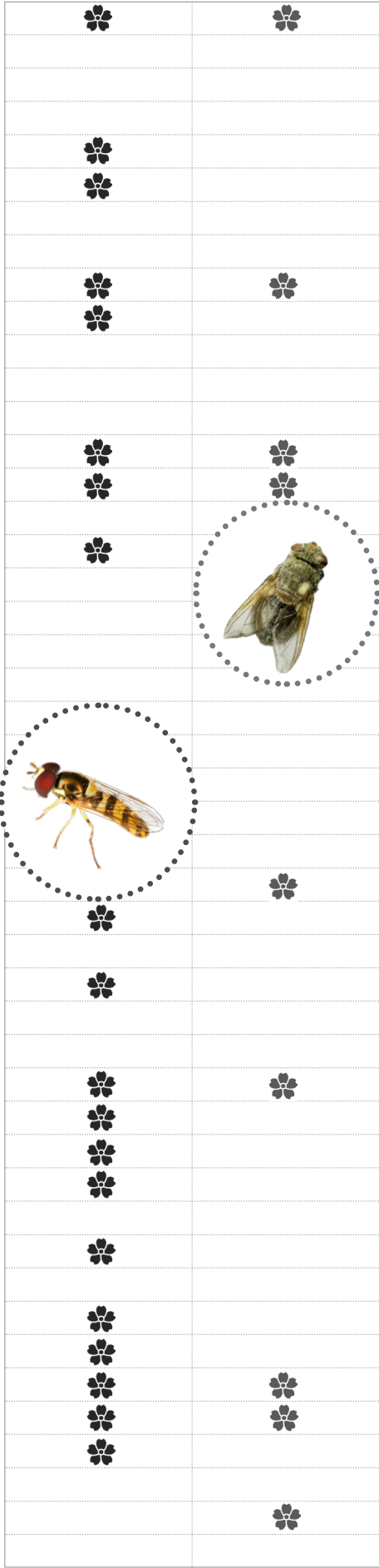


Flies

Figure 4.2.10

Achillea millifolium
Elymus repens
Amaranthus retroflexus
Ambrosia psilostachya
Arctium minus
Argentina anserina
Artemisia absinthium
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Symphyotrichum ericoides
Taraxacum officinale
Trifolium pratense
Trifolium repens
Vicia cracca

Flower flies
Syrphidae
Parasitic flies
Tachinidae





Songbirds support

This section records songbirds that are reported visiting these 47 ‘weeds.’ As these birds are also reported in Southern Manitoba, it’s possible that these ‘weeds’ can offer the seasonal food source to these songbirds in the city.

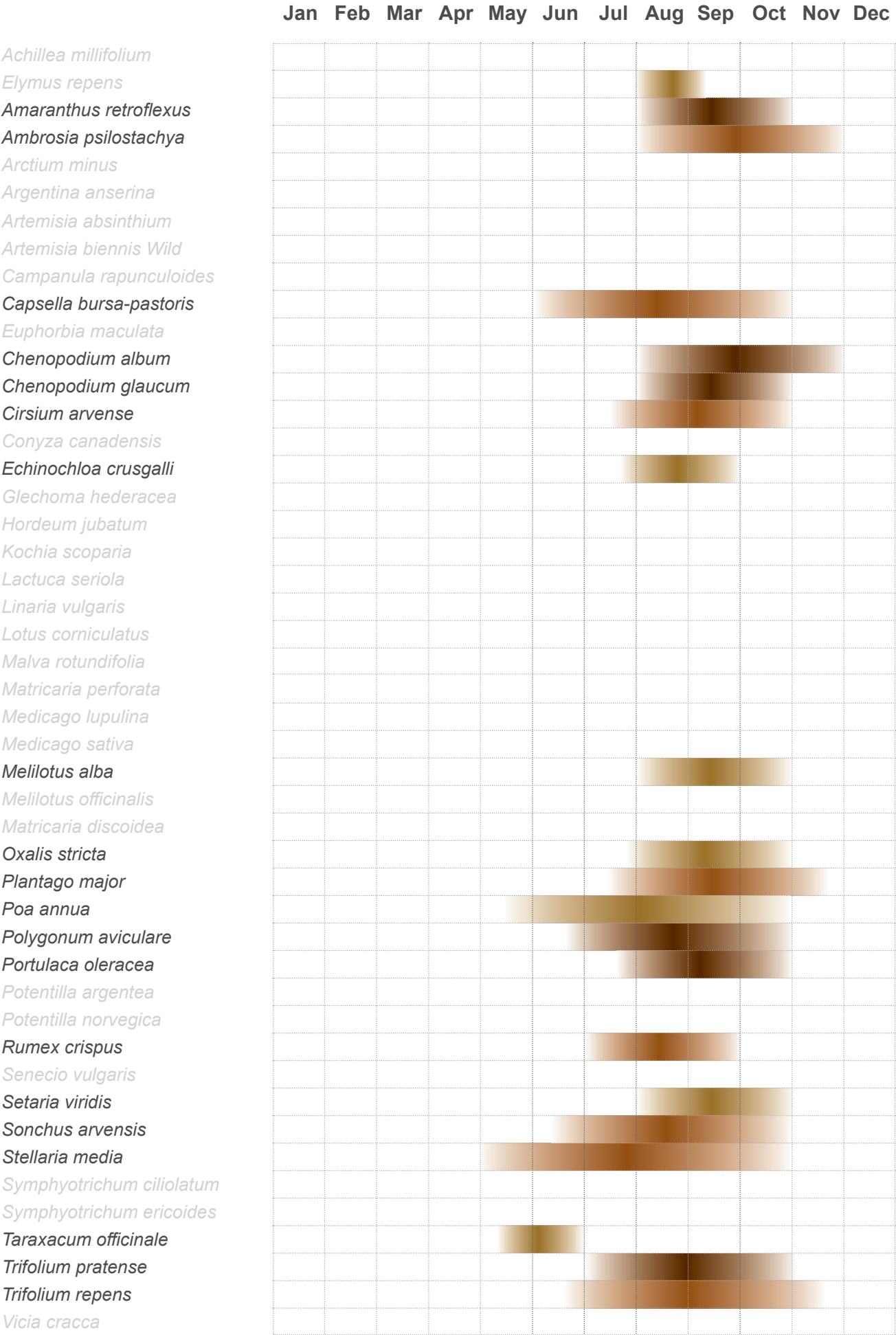
The birds species recorded in this section are all native birds in Canada except House sparrow (*Passer domesticus*) which is a native in Europe and Asia.

Legend:

 Seeds feeding on

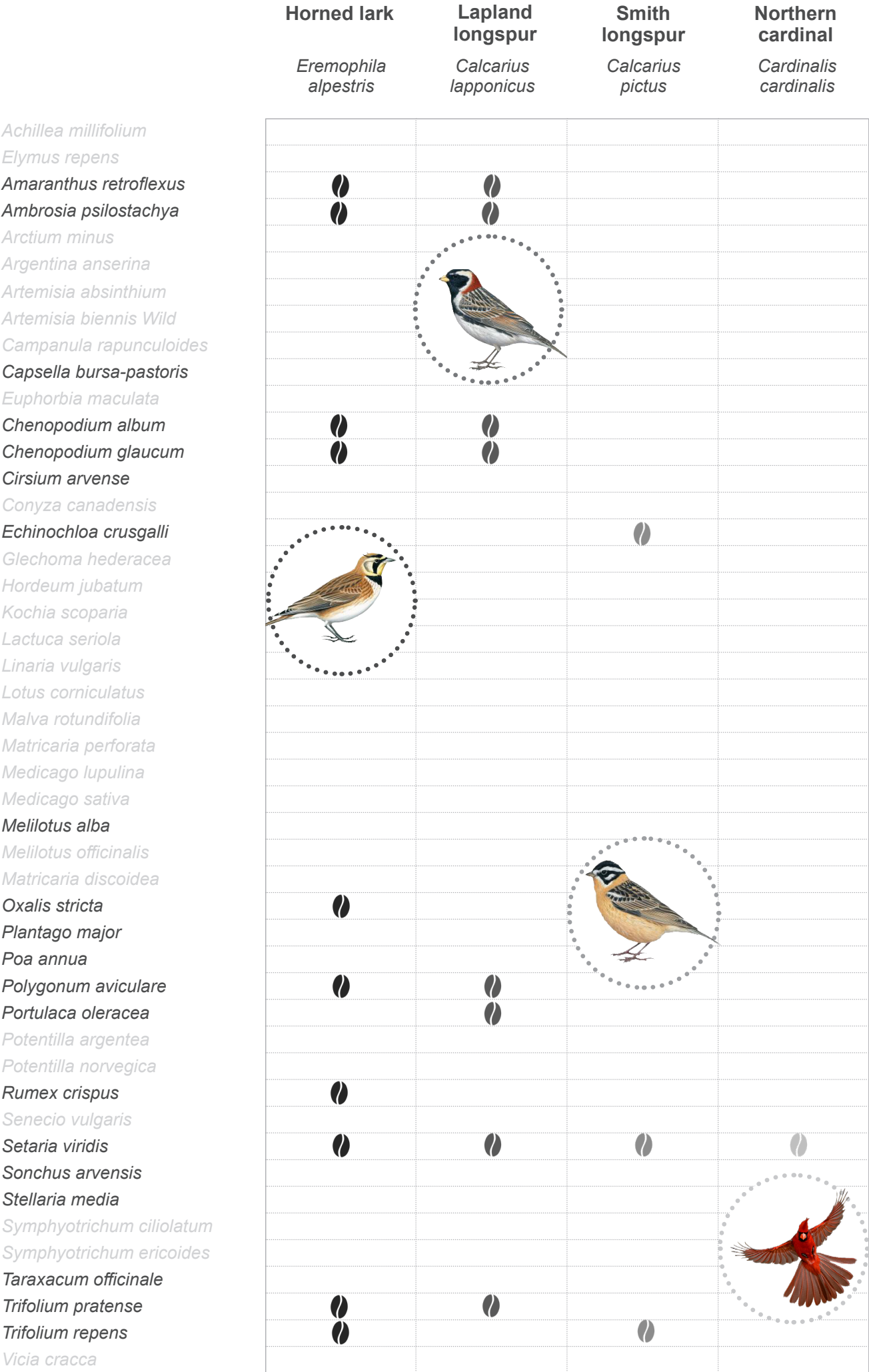
Seeding time

Figure 4.2.12



Songbirds

Figure 4.2.13

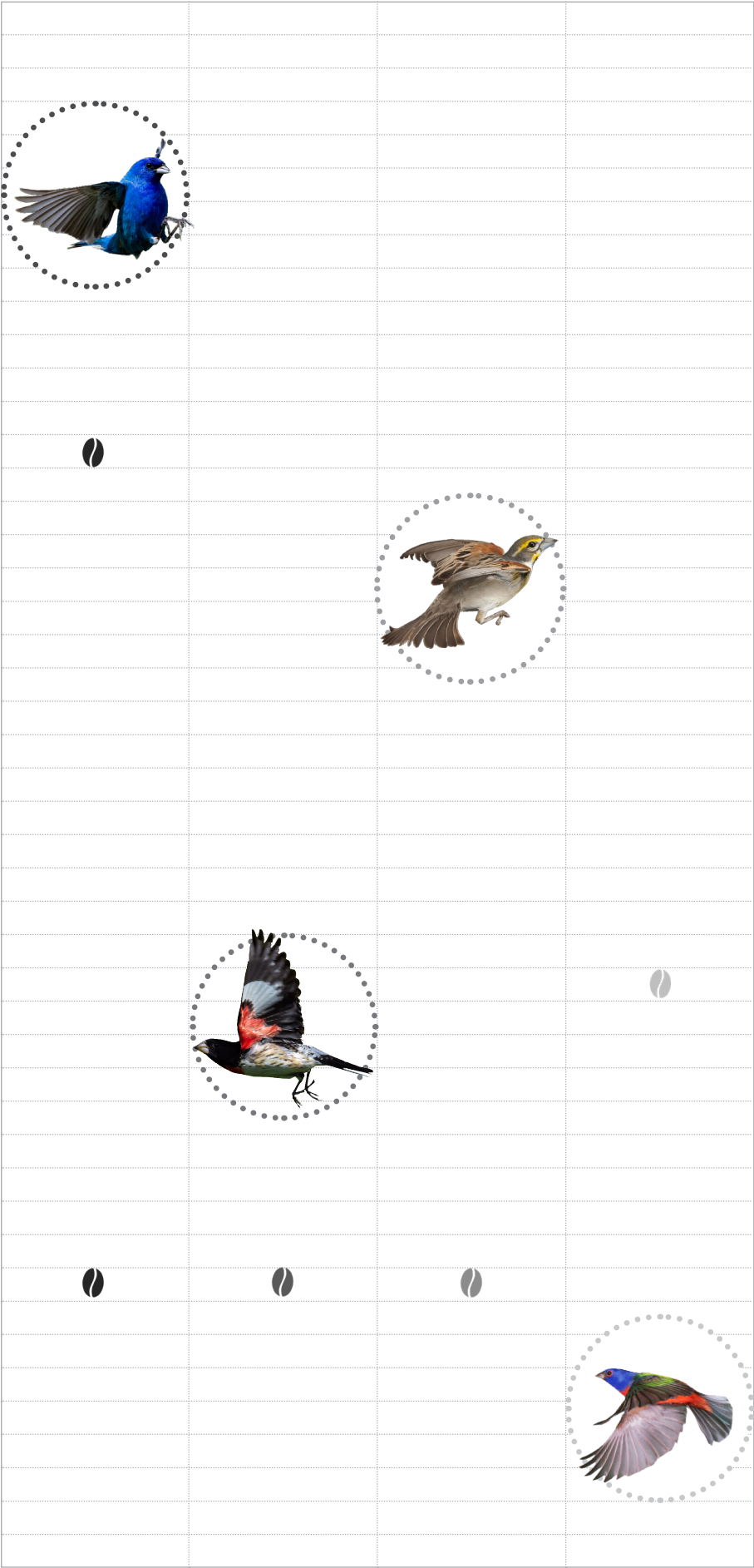


Songbirds

Figure 4.2.13

Achillea millifolium
Elymus repens
Amaranthus retroflexus
Ambrosia psilostachya
Arctium minus
Argentina anserina
Artemisia absinthium
Artemisia biennis Wild
Campanula rapunculoides
Capsella bursa-pastoris
Euphorbia maculata
Chenopodium album
Chenopodium glaucum
Cirsium arvense
Conyza canadensis
Echinochloa crusgalli
Glechoma hederacea
Hordeum jubatum
Kochia scoparia
Lactuca seriola
Linaria vulgaris
Lotus corniculatus
Malva rotundifolia
Matricaria perforata
Medicago lupulina
Medicago sativa
Melilotus alba
Melilotus officinalis
Matricaria discoidea
Oxalis stricta
Plantago major
Poa annua
Polygonum aviculare
Portulaca oleracea
Potentilla argentea
Potentilla norvegica
Rumex crispus
Senecio vulgaris
Setaria viridis
Sonchus arvensis
Stellaria media
Symphyotrichum ciliolatum
Symphyotrichum ericoides
Taraxacum officinale
Trifolium pratense
Trifolium repens
Vicia cracca

Indigo bunting
Passerina cyanea
Rose-breasted grosbeak
Pheucticus ludovicianus
Dickcissel
Spiza americana
Painted bunting
Passerina ciris

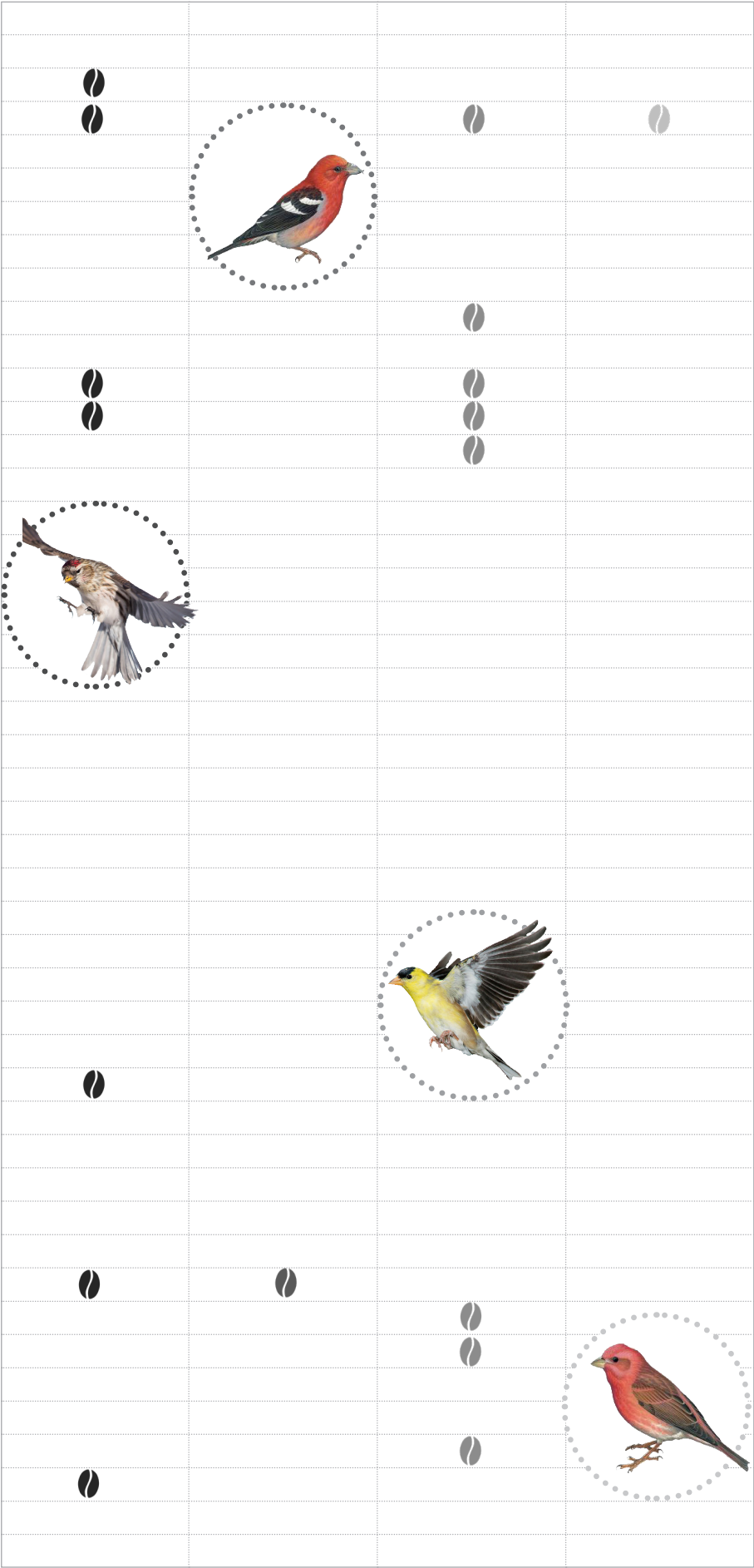


Songbirds

Figure 4.2.13

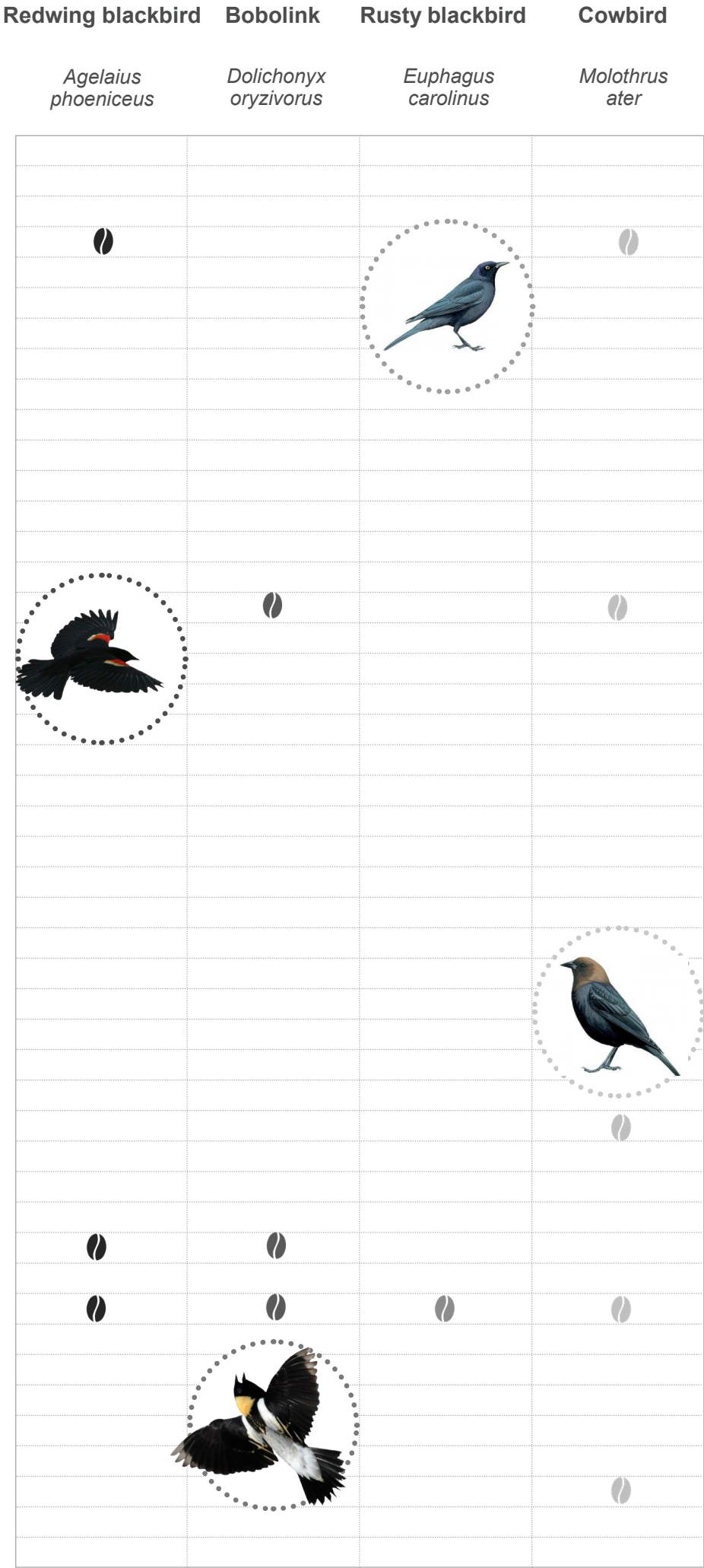
Achillea millifolium
Elymus repens
Amaranthus retroflexus
Ambrosia psilostachya
Arctium minus
Argentina anserina
Artemisia absinthium
Artemisia biennis Wild
Campanula rapunculoides
Capsella bursa-pastoris
Euphorbia maculata
Chenopodium album
Chenopodium glaucum
Cirsium arvense
Conyza canadensis
Echinochloa crusgalli
Glechoma hederacea
Hordeum jubatum
Kochia scoparia
Lactuca seriola
Linaria vulgaris
Lotus corniculatus
Malva rotundifolia
Matricaria perforata
Medicago lupulina
Medicago sativa
Melilotus alba
Melilotus officinalis
Matricaria discoidea
Oxalis stricta
Plantago major
Poa annua
Polygonum aviculare
Portulaca oleracea
Potentilla argentea
Potentilla norvegica
Rumex crispus
Senecio vulgaris
Setaria viridis
Sonchus arvensis
Stellaria media
Symphyotrichum ciliolatum
Symphyotrichum ericoides
Taraxacum officinale
Trifolium pratense
Trifolium repens
Vicia cracca

Common redpoll
Acanthis flammea
White-winged crossbill
Loxia leucoptera
American goldfinch
Carduelis tristis
Purple finch
Carpodacus purpureus



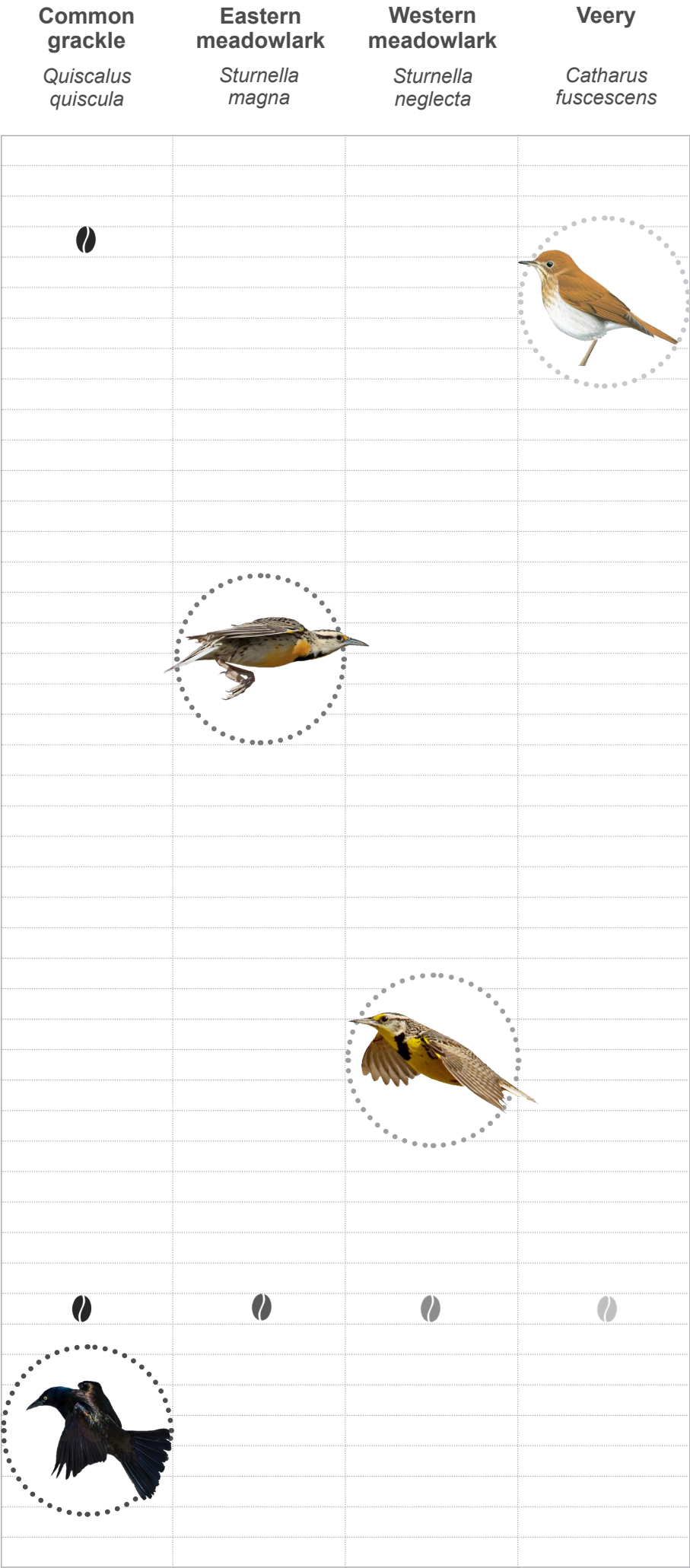
Songbirds

Figure 4.2.13



Songbirds

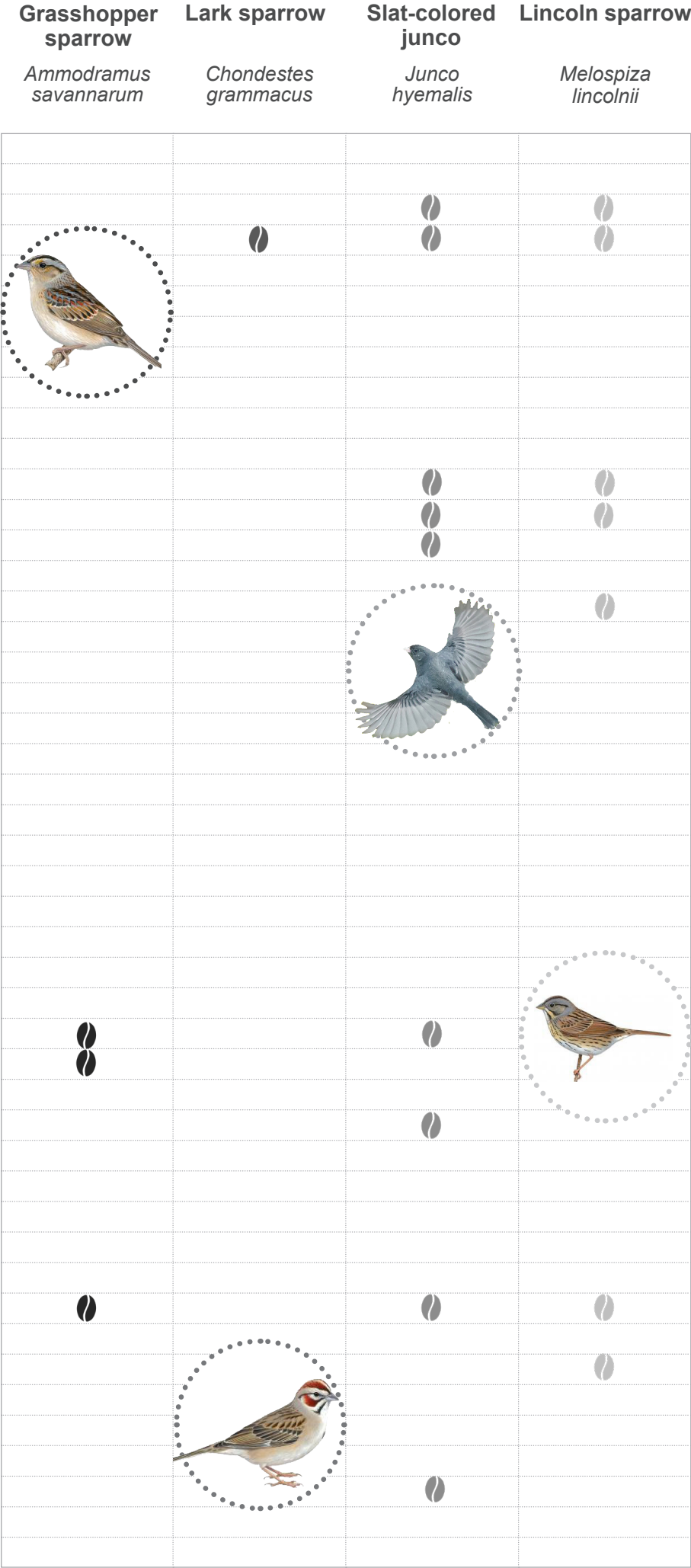
Figure 4.2.13



Songbirds

Figure 4.2.13

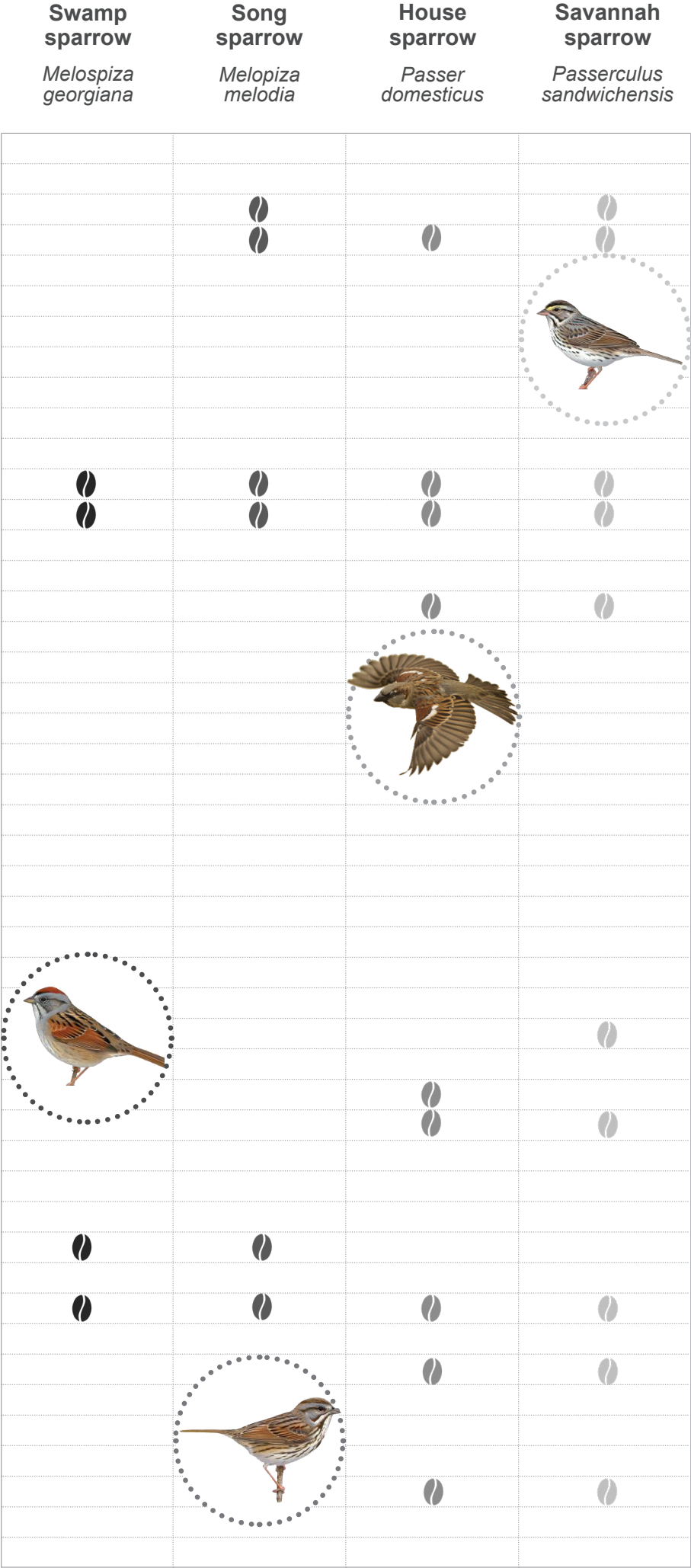
Achillea millifolium
Elymus repens
Amaranthus retroflexus
Ambrosia psilostachya
Arctium minus
Argentina anserina
Artemisia absinthium
Artemisia biennis Wild
Campanula rapunculoides
Capsella bursa-pastoris
Euphorbia maculata
Chenopodium album
Chenopodium glaucum
Cirsium arvense
Conyza canadensis
Echinochloa crusgalli
Glechoma hederacea
Hordeum jubatum
Kochia scoparia
Lactuca seriola
Linaria vulgaris
Lotus corniculatus
Malva rotundifolia
Matricaria perforata
Medicago lupulina
Medicago sativa
Melilotus alba
Melilotus officinalis
Matricaria discoidea
Oxalis stricta
Plantago major
Poa annua
Polygonum aviculare
Portulaca oleracea
Potentilla argentea
Potentilla norvegica
Rumex crispus
Senecio vulgaris
Setaria viridis
Sonchus arvensis
Stellaria media
Symphyotrichum ciliolatum
Symphyotrichum ericoides
Taraxacum officinale
Trifolium pratense
Trifolium repens
Vicia cracca



Songbirds

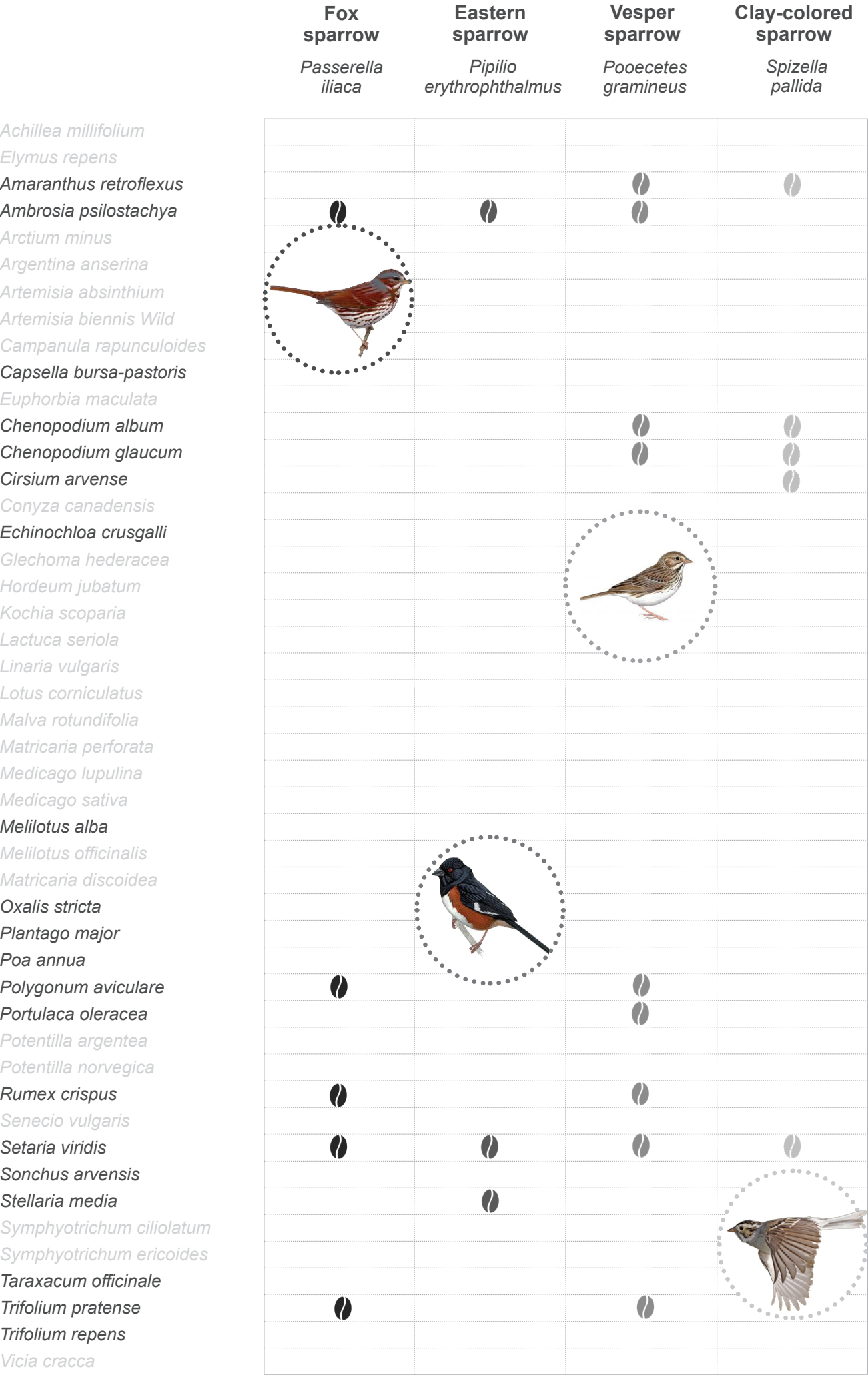
Figure 4.2.13

Achillea millifolium
Elymus repens
Amaranthus retroflexus
Ambrosia psilostachya
Arctium minus
Argentina anserina
Artemisia absinthium
Artemisia biennis Wild
Campanula rapunculoides
Capsella bursa-pastoris
Euphorbia maculata
Chenopodium album
Chenopodium glaucum
Cirsium arvense
Conyza canadensis
Echinochloa crusgalli
Glechoma hederacea
Hordeum jubatum
Kochia scoparia
Lactuca seriola
Linaria vulgaris
Lotus corniculatus
Malva rotundifolia
Matricaria perforata
Medicago lupulina
Medicago sativa
Melilotus alba
Melilotus officinalis
Matricaria discoidea
Oxalis stricta
Plantago major
Poa annua
Polygonum aviculare
Portulaca oleracea
Potentilla argentea
Potentilla norvegica
Rumex crispus
Senecio vulgaris
Setaria viridis
Sonchus arvensis
Stellaria media
Symphyotrichum ciliolatum
Symphyotrichum ericoides
Taraxacum officinale
Trifolium pratense
Trifolium repens
Vicia cracca



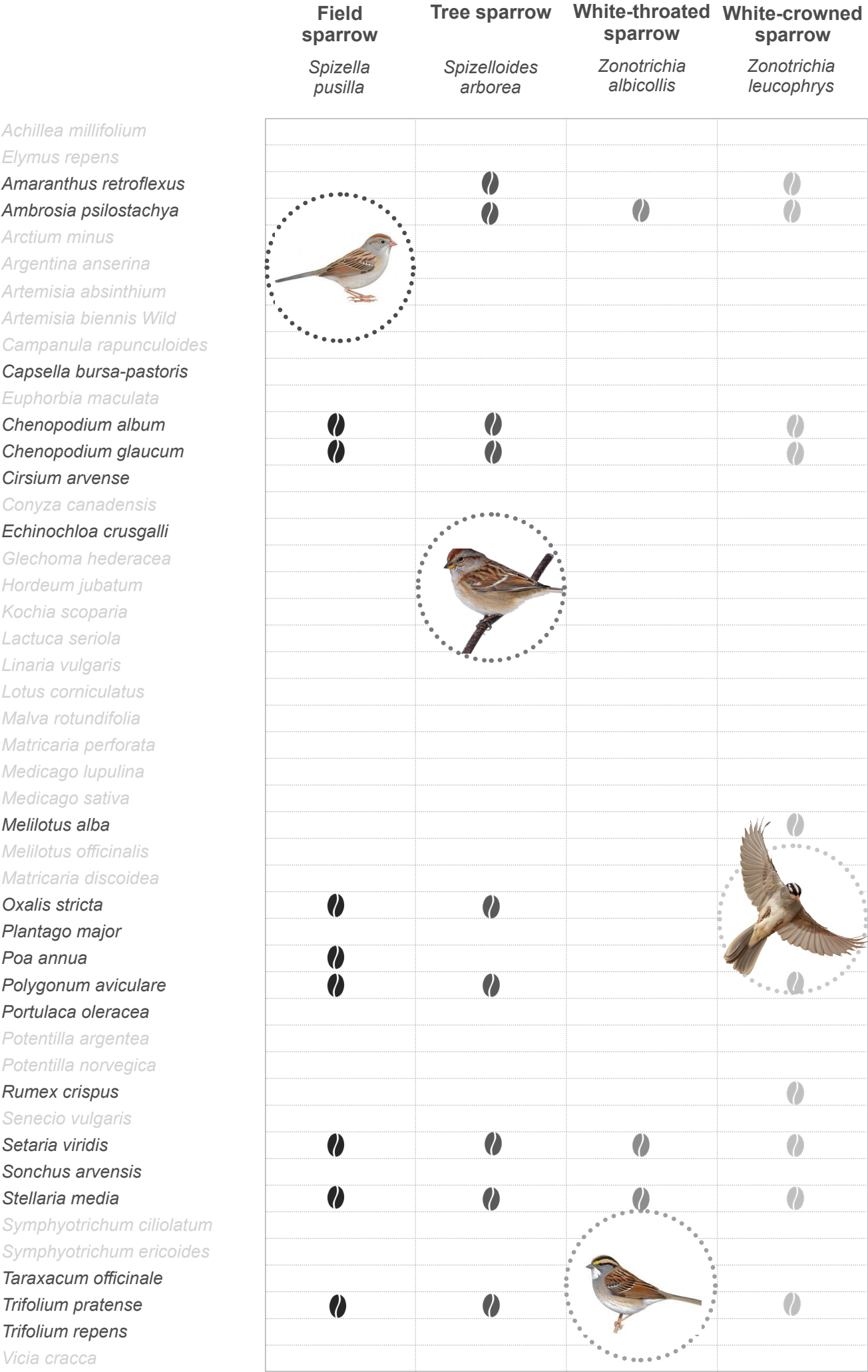
Songbirds

Figure 4.2.13



Songbirds

Figure 4.2.13



Foraging value

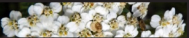
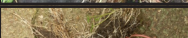
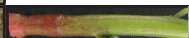
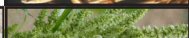
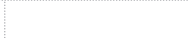
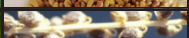
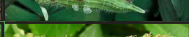
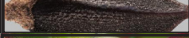
This section records the foraging value of ‘weeds.’ Throughout history and even today, what we called ‘weeds’ in Winnipeg are used as valuable foods. The nutrition value of some of these species is quite high. However, despite the recommendation to utilize these species as food, much caution is required as some may be toxic if ingested in large quantities at once, or if foraged in a polluted environment. Moreover, even though I demonstrate the nutritional value they may contain, this value is impacted by the specific growing environment.

*Therefore, it is necessary to consult the expert scientist or experienced expert food forager before any human consumption occurs.



Edible parts

Figure 4.2.15

	Roots	Stems	Leaves	Seeds	Flowers
<i>Achillea millifolium</i>					
<i>Elymus repens</i>					
<i>Amaranthus retroflexus</i>					
<i>Ambrosia psilostachya</i>					
<i>Arctium minus</i>					
<i>Argentina anserina</i>					
<i>Artemisia absinthium</i>					
<i>Artemisia biennis</i> Wild					
<i>Campanula rapunculoides</i>					
<i>Capsella bursa-pastoris</i>					
<i>Euphorbia maculata</i>					
<i>Chenopodium album</i>					
<i>Chenopodium glaucum</i>					
<i>Cirsium arvense</i>					
<i>Conyza canadensis</i>					
<i>Echinochloa crusgalli</i>					
<i>Glechoma hederacea</i>					
<i>Hordeum jubatum</i>					
<i>Kochia scoparia</i>					
<i>Lactuca seriola</i>					
<i>Linaria vulgaris</i>					
<i>Lotus corniculatus</i>					
<i>Malva rotundifolia</i>					
<i>Matricaria perforata</i>					
<i>Medicago lupulina</i>					
<i>Medicago sativa</i>					
<i>Melilotus alba</i>					
<i>Melilotus officinalis</i>					
<i>Matricaria discoidea</i>					
<i>Oxalis stricta</i>					
<i>Plantago major</i>					
<i>Poa annua</i>					
<i>Polygonum aviculare</i>					
<i>Portulaca oleracea</i>					
<i>Potentilla argentea</i>					
<i>Potentilla norvegica</i>					
<i>Rumex crispus</i>					
<i>Senecio vulgaris</i>					
<i>Setaria viridis</i>					
<i>Sonchus arvensis</i>					
<i>Stellaria media</i>					
<i>Symphyotrichum ciliolatum</i>					
<i>Symphyotrichum ericoides</i>					
<i>Taraxacum officinale</i>					
<i>Trifolium pratense</i>					
<i>Trifolium repens</i>					
<i>Vicia cracca</i>					

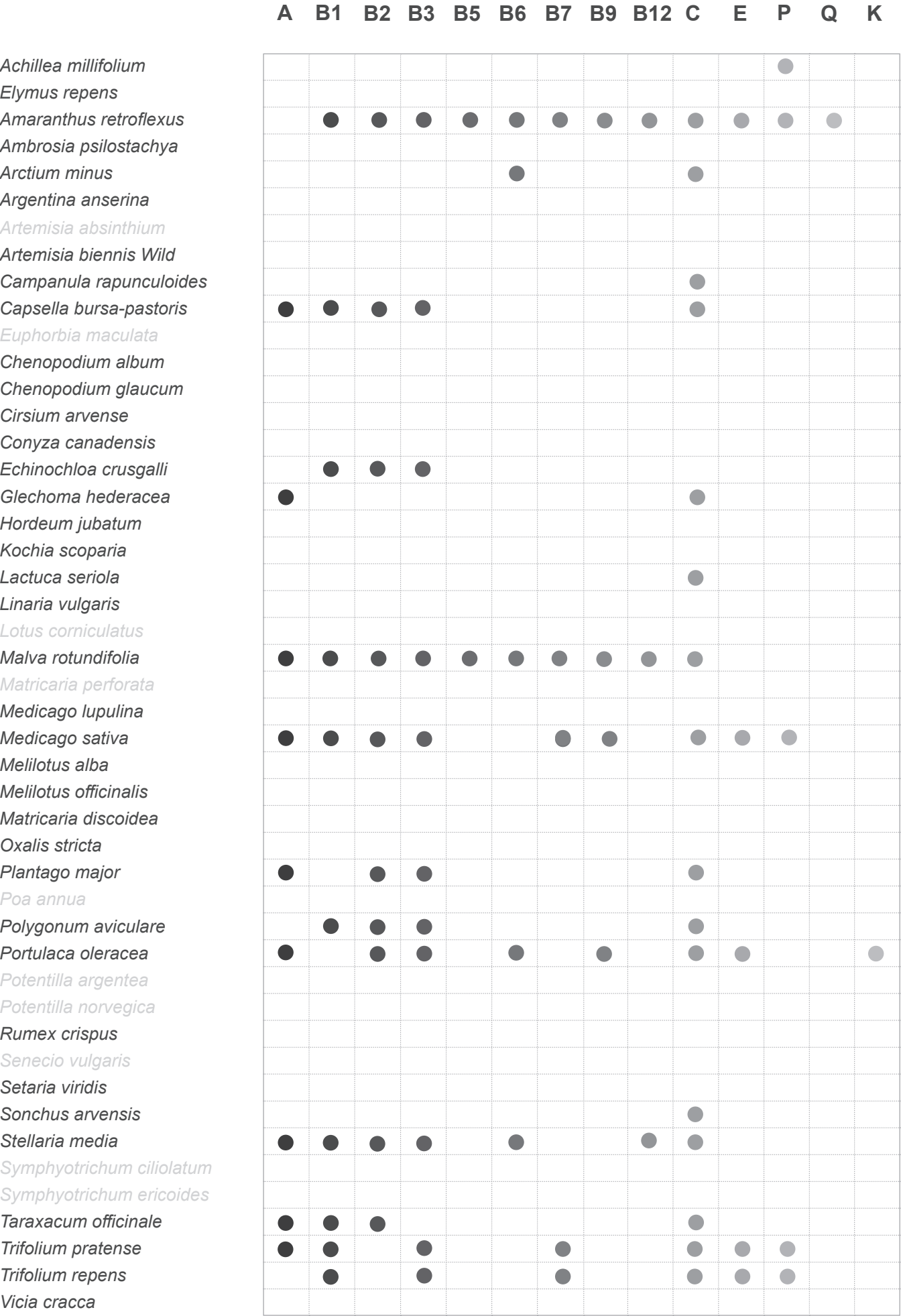
Nutrition value - vitamin

Figure 4.2.16

	Li	Na	Mg	P	Cl	K	Ca	Cr	Mn	Fe	Cu	Zn	Se	I
<i>Achillea millifolium</i>		●	●	●		●	●		●					
<i>Elymus repens</i>					●	●								
<i>Amaranthus retroflexus</i>		●	●	●		●	●		●	●		●	●	
<i>Ambrosia psilostachya</i>														
<i>Arctium minus</i>														
<i>Argentina anserina</i>														
<i>Artemisia absinthium</i>														
<i>Artemisia biennis</i> Wild														
<i>Campanula rapunculoides</i>														
<i>Capsella bursa-pastoris</i>		●	●	●	●	●	●			●				
<i>Euphorbia maculata</i>														
<i>Chenopodium album</i>			●	●		●	●		●	●				
<i>Chenopodium glaucum</i>														
<i>Cirsium arvense</i>						●	●							
<i>Conyza canadensis</i>						●	●							
<i>Echinochloa crusgalli</i>		●	●	●			●		●	●		●		
<i>Glechoma hederacea</i>														
<i>Hordeum jubatum</i>														
<i>Kochia scoparia</i>				●										
<i>Lactuca seriola</i>														
<i>Linaria vulgaris</i>														
<i>Lotus corniculatus</i>														
<i>Malva rotundifolia</i>		●	●			●	●			●		●	●	●
<i>Matricaria perforata</i>														
<i>Medicago lupulina</i>			●	●		●	●							
<i>Medicago sativa</i>		●	●	●		●	●		●	●	●	●		
<i>Melilotus alba</i>														
<i>Melilotus officinalis</i>														
<i>Matricaria discoidea</i>														
<i>Oxalis stricta</i>							●							
<i>Plantago major</i>		●		●	●	●	●			●				
<i>Poa annua</i>														
<i>Polygonum aviculare</i>		●	●	●		●	●			●		●		
<i>Portulaca oleracea</i>	●	●	●	●		●	●							
<i>Potentilla argentea</i>														
<i>Potentilla norvegica</i>														
<i>Rumex crispus</i>			●	●		●	●		●	●	●			
<i>Senecio vulgaris</i>														
<i>Setaria viridis</i>		●	●	●		●	●		●	●		●		
<i>Sonchus arvensis</i>														
<i>Stellaria media</i>			●	●		●	●		●	●	●	●	●	
<i>Symphyotrichum ciliolatum</i>														
<i>Symphyotrichum ericoides</i>														
<i>Taraxacum officinale</i>		●	●	●	●	●	●	●		●	●			
<i>Trifolium pratense</i>			●	●			●	●	●	●		●		
<i>Trifolium repens</i>		●	●	●		●	●			●				
<i>Vicia cracca</i>														

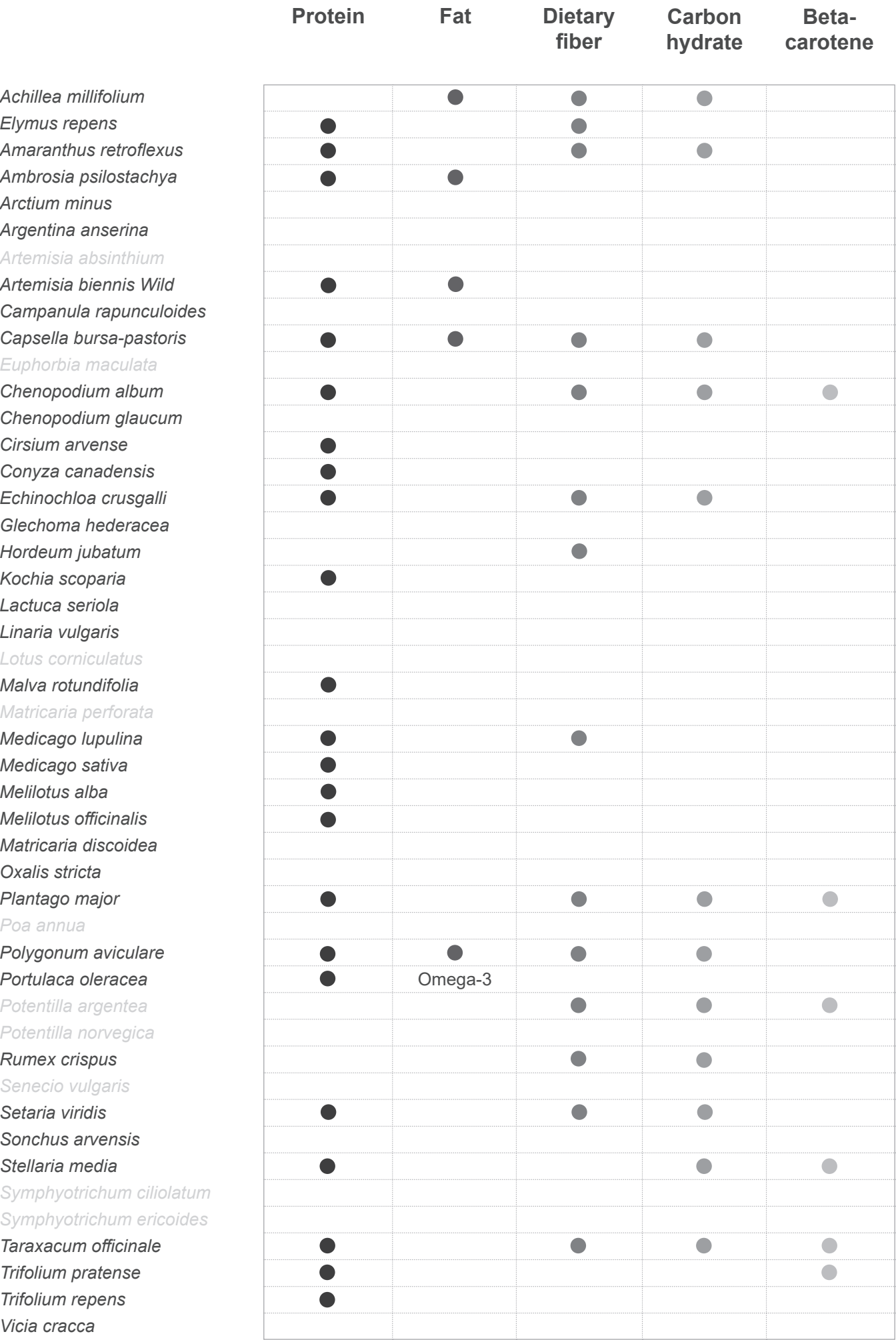
Nutrition value - minerals

Figure 4.2.16



Nutrition value - other ingredient

Figure 4.2.16





Soil remediation

This section records the soil remediation functions of these ‘weeds’. Acknowledging the soil remediation functions of these ‘weeds’ can make residents aware of their ecological benefits to the soil compared with the pollution caused by the lawn and its maintenance.

Most of these ‘weeds’ can protect the soil from erosion either by their rapid spread speed to cover the soil or by their fibrous roots to stabilize the soil. All of these ‘weeds’ in the leguminous family are able to fix the nitrogen in the soil, as there are *rhizobium* bacteria within the root nodes of these ‘weeds’. Some ‘weeds’ also possess phytoremediation function. The phytoremediation function is classified as phytoextraction, phytodegradation, rhizodegradation or simply tolerance to the contaminants. For the phytoextraction, the plants would only extract the pollutants to their body, but may not dissolve them (Kennen and Kirkwood, 2015). For the phytodegradation, plants can remove the pollutant to their upper body and then dissolve

the contaminants to smaller parts (Kennen and Kirkwood, 2015). The rhizodegradation means that the microbes accumulated around the root system of a certain plant can dissolve the pollutant in the soil (Kennen and Kirkwood, 2015).

The content in this section is a demonstration of the remediation possibilities of these ‘weeds’. Because different types of soil have different influences for the remediated effects of these ‘weeds’, to put the theories into practice, experiments are still necessary on individual sites.

Legend:

TPH	Total petroleum hydrocarbons
PAH	Polycyclic aromatic hydrocarbon

	Erosion control	Nitrogen	Phytoremediation
<i>Achillea millifolium</i>	●		
<i>Elymus repens</i>	●		●
<i>Amaranthus retroflexus</i>			
<i>Ambrosia psilostachya</i>			
<i>Arctium minus</i>			
<i>Argentina anserina</i>	●		
<i>Artemisia absinthium</i>			
<i>Artemisia biennis</i> Wild			
<i>Campanula rapunculoides</i>			
<i>Capsella bursa-pastoris</i>			
<i>Euphorbia maculata</i>			
<i>Chenopodium album</i>	●		●
<i>Chenopodium glaucum</i>			
<i>Cirsium arvense</i>			
<i>Conyza canadensis</i>	●		
<i>Echinochloa crusgalli</i>			●
<i>Glechoma hederacea</i>	●		
<i>Hordeum jubatum</i>	●		●
<i>Kochia scoparia</i>			●
<i>Lactuca seriola</i>			
<i>Linaria vulgaris</i>	●		
<i>Lotus corniculatus</i>	●	●	●
<i>Malva rotundifolia</i>			
<i>Matricaria perforata</i>			
<i>Medicago lupulina</i>		●	
<i>Medicago sativa</i>		●	●
<i>Melilotus alba</i>		●	
<i>Melilotus officinalis</i>		●	●
<i>Matricaria discoidea</i>			
<i>Oxalis stricta</i>			
<i>Plantago major</i>	●		●
<i>Poa annua</i>			
<i>Polygonum aviculare</i>	●		
<i>Portulaca oleracea</i>	●		
<i>Potentilla argentea</i>			
<i>Potentilla norvegica</i>			
<i>Rumex crispus</i>			
<i>Senecio vulgaris</i>			
<i>Setaria viridis</i>			
<i>Sonchus arvensis</i>	●		
<i>Stellaria media</i>			
<i>Symphyotrichum ciliolatum</i>	●		
<i>Symphyotrichum ericoides</i>	●		
<i>Taraxacum officinale</i>			
<i>Trifolium pratense</i>		●	●
<i>Trifolium repens</i>		●	●
<i>Vicia cracca</i>		●	

	Phytoextraction
<i>Achillea millifolium</i>	
<i>Elymus repens</i>	
<i>Amaranthus retroflexus</i>	Sr Cr U
<i>Ambrosia psilostachya</i>	
<i>Arctium minus</i>	
<i>Argentina anserina</i>	
<i>Artemisia absinthium</i>	
<i>Artemisia biennis</i> Wild	
<i>Campanula rapunculoides</i>	
<i>Capsella bursa-pastoris</i>	
<i>Euphorbia maculata</i>	
<i>Chenopodium album</i>	Cr Ni Cu Zn Cd Pb
<i>Chenopodium glaucum</i>	
<i>Cirsium arvense</i>	
<i>Conyza canadensis</i>	Cr Cd
<i>Echinochloa crusgalli</i>	
<i>Glechoma hederacea</i>	
<i>Hordeum jubatum</i>	
<i>Kochia scoparia</i>	Cr Ag Cs Hg PAH
<i>Lactuca seriola</i>	Cr Ni Cu Zn Cd Pb
<i>Linaria vulgaris</i>	
<i>Lotus corniculatus</i>	B Zn Se
<i>Malva rotundifolia</i>	
<i>Matricaria perforata</i>	
<i>Medicago lupulina</i>	
<i>Medicago sativa</i>	Fe Ni Zn Cd Pb
<i>Melilotus alba</i>	
<i>Melilotus officinalis</i>	
<i>Matricaria discoidea</i>	
<i>Oxalis stricta</i>	
<i>Plantago major</i>	
<i>Poa annua</i>	
<i>Polygonum aviculare</i>	
<i>Portulaca oleracea</i>	Ar Cr Fe Zn Cd
<i>Potentilla argentea</i>	
<i>Potentilla norvegica</i>	
<i>Rumex crispus</i>	
<i>Senecio vulgaris</i>	
<i>Setaria viridis</i>	
<i>Sonchus arvensis</i>	
<i>Stellaria media</i>	
<i>Symphyotrichum ciliolatum</i>	
<i>Symphyotrichum ericoides</i>	
<i>Taraxacum officinale</i>	Cr Mn Co Cu Zn As Se Br Cd Sb Hg Pb
<i>Trifolium pratense</i>	B Cu Zn Se Cd Pb
<i>Trifolium repens</i>	Zn Cd Pb
<i>Vicia cracca</i>	

Soil remediation

Figure 4.2.18



Conclusion

By revealing specific benefits that these plants can offer us, it could increase the possibilities that residents will treasure and even utilize in their daily lives.

CHAPTER 5

A 'weeds' experimental garden



The overview of Assiniboine Park

Figure 5.1



The overview of site location

Figure 5.2

To let residents recognize the value of 'weeds,' the chosen site of this experimental garden is in the public Assiniboine Park, in the City of Winnipeg. The specific location is in the former Herbarium which has already been demolished. The current Park plans for the site are to replenish the soil, plant trees, and use as a picnic place.

Although we emphasize the value of these prolific 'weeds,' we have never purposefully planted them together. Therefore, to control their spread to reduce their unpredictable influence for other areas of the park, the site with the dense forest buffer is appropriate to avoid the spread of the fecund plants. Moreover, the dense forest can also create a feeling of a secret garden that is located in a mysterious forest.

Site analysis



1. The Leaf

2. The Indigenous People's Garden

3. The Grove
4. The Cultural Mosaic Gardens

A. The Kitchen Garden

B. The Performance Garden
- C. The Sensory Garden

D. The Seasonal Garden

Canada's Diversity Garden and site location

Canada's Diversity Garden is a building project near the site, which is in the final developmental stage for Assiniboine Park (Assiniboine Park, n.d.). The vision of Canada's Diversity Garden is to let people appreciate the culture between the people and plants throughout Canadian history (Assiniboine Park, n.d.). There are mainly four sections for the combination of the garden - The Leaf, The Indigenous People's Garden, The Grove, and The Cultural Mosaic Garden (Assiniboine Park, n.d.).

'Weeds' have kept company with human footprints throughout history in a complicated relationship as has been discussed earlier in this document. Therefore, the main theme of the 'weeds'

garden is in correspondence with Canada's Diversity Garden. Not only they are in the same theme, but the 'weeds' garden can also get support from Canada's Diversity Garden in the future. The popularity of Canada's Diversity Garden could bring more visitors to the site, creating more opportunities for people to recognize the value of the 'weeds'. More importantly, these two gardens can also share the same facilities. For example, there are kitchens and educational program that would take place in the Leaf, which the 'weeds' garden could take advantage of to educate people to learn the value of 'weeds'.

Site analysis



- Existing forest

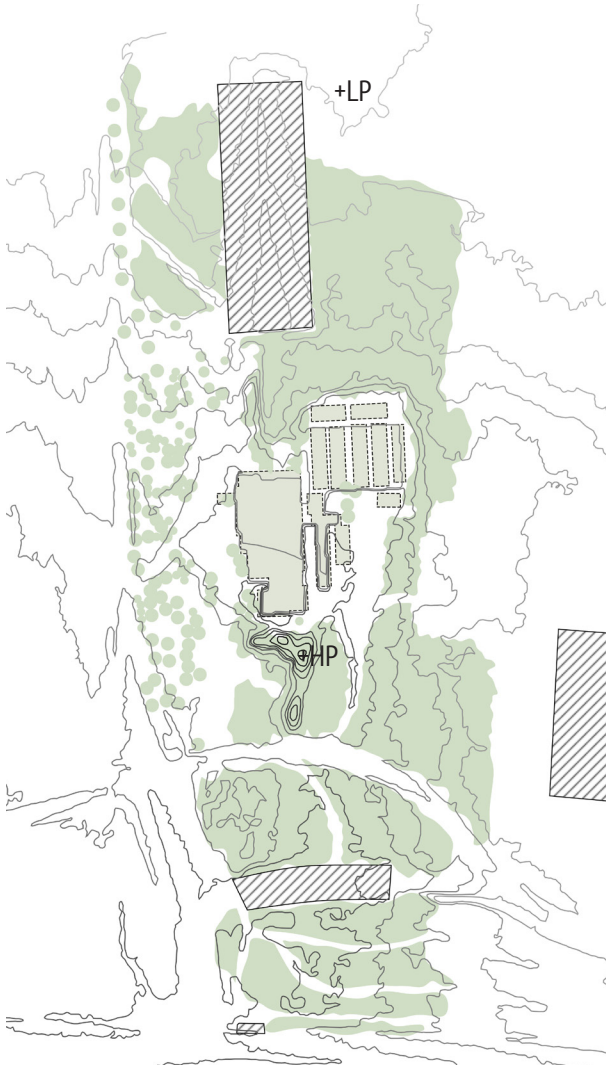
Major road

Walking path
- Parking lots

Bus stop

Former Herbarium

The first diagram illustrates a dense forest, major traffic for cars, walking paths, parking lots and a bus stop surrounding the site.



- Existing forest

Parking lots

Bus stop
- Former Herbarium

Contour lines

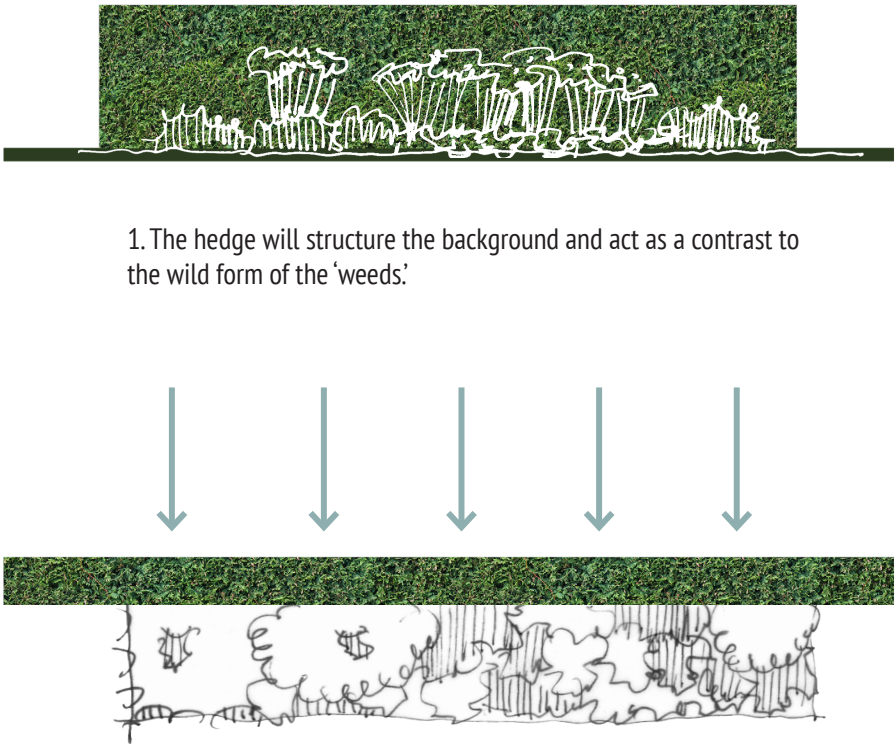
0.25 m interval

As topography lines illustrate, besides the mound at the south side of the former Herbarium, the site is almost flat.

Concept of design

There are two main concepts of the design. The first is the use of hedge; the second is to form the space by the seasonal color and texture of plants.

Concept 1: The use of hedge



1. The hedge will structure the background and act as a contrast to the wild form of the 'weeds.'

2. It will block the wind and work to avoid the spread of 'weeds.'

Figure 5.5

There are two main uses of the hedge. The beauty lies in contrast. The wildness of the 'weeds' can play as a contrast to the strict, pruned shape of the hedge. Also, Brandon cedar, Mugo pine and Contoneaster selected for the hedge with its solid green color would play as a contrast to the bright flowering color of 'weeds,' thereby making the color and the texture of 'weeds' stand out.

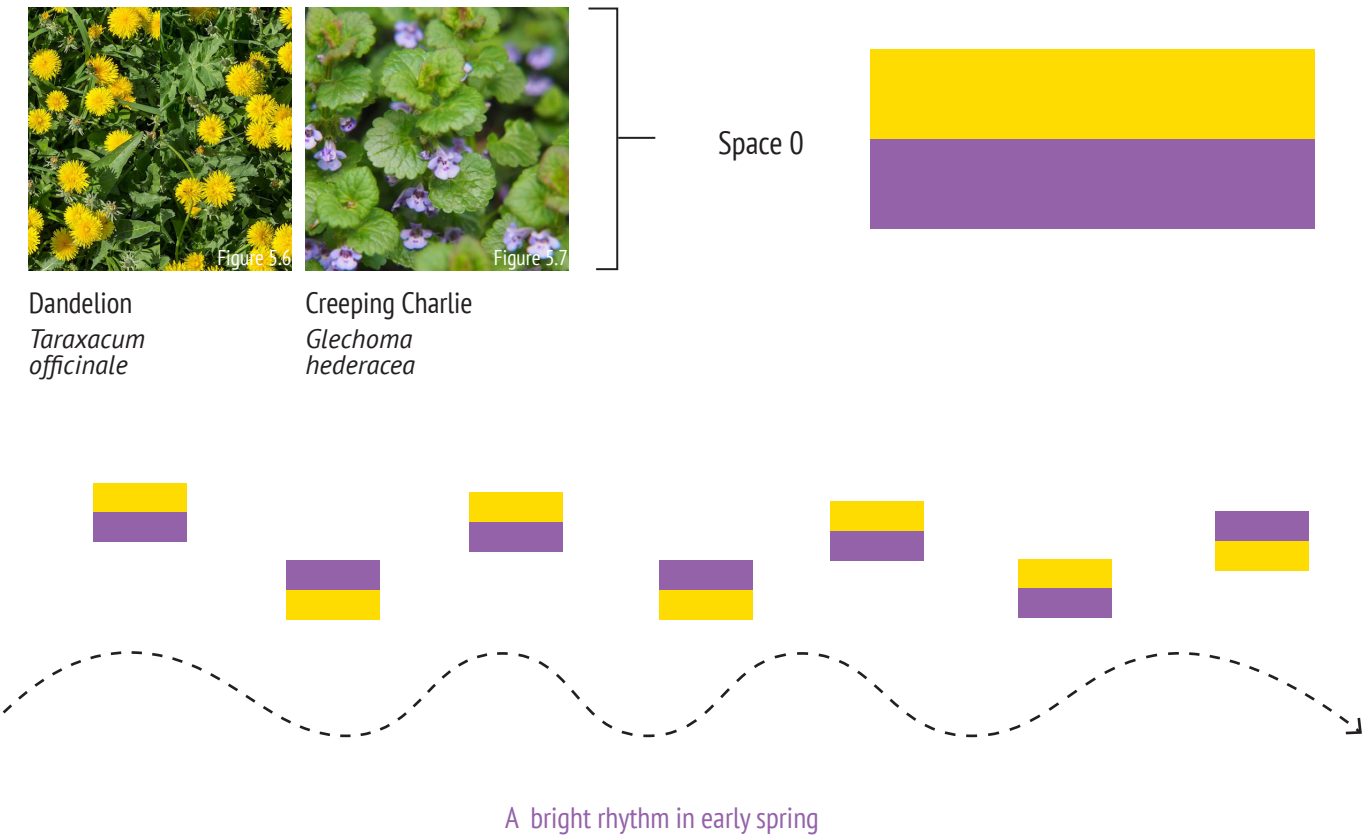
The second use of hedge is to block the wind in the seeding season, thereby avoiding the spread of these prolific species to keep this experimental garden under control.

Concept of design

Concept 2: The use of seasonal color and texture of plants

To make the garden beautiful and legible, spaces within the garden are organized through the combination of the seasonal color along with texture of plants.

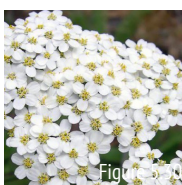
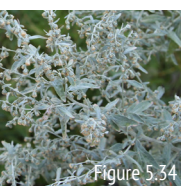
1. Spring

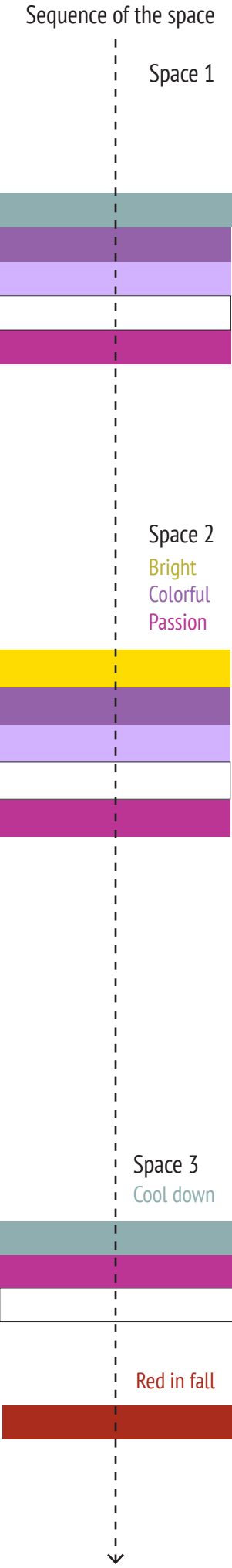


In the spring, the yellow flowering color of Dandelion and the purple flowering color of Creeping charlie would form the main color theme and be planted together to create the space zero.

In the summer, the space one formed by Absinthe, Lindley's aster, Canada thistle, Alfalfa, White clover, Round-leaved mallow, Red clover and Heath aster would create an elegant, cold and calm space at the beginning of the visiting sequence. Then, space two formed by Birdsfoot trefoil, Black medick, Yellow woodsorrel, Silverweeds, Silvery cinquefoil, Rough cinquefoil, Lindley's aster, Canada thistle, Alfalfa, Pink yarrow and Scentless chamomile would form a bright color theme which is also the climax of the whole visiting route. Finally, visitors would come to space three which is created by Scentless chamomile, White yarrow, Pink yarrow, Absinthe, Lamb's quarters, Canada fleabane and Kochia. All plants in space three would play a cool color pattern which makes visitors calm down again after visiting the space two.

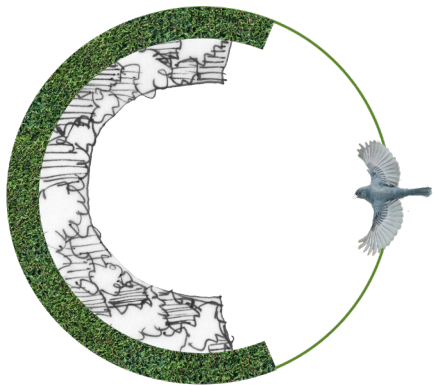
2. Summer

 Absinthe <i>Artemisia absinthium</i>	 Lindley's aster <i>Symphyotrichum ciliolatum</i>	 Canada thistle <i>Cirsium arvense</i>	 Alfalfa <i>Medicago sativa</i>	 White clover <i>Trifolium repens</i>
 Round-leaved mallow <i>Malva pusilla</i>	 Red clover <i>Trifolium pratense</i>	 Heath aster <i>Symphyotrichum ericoides</i>		
 Birdsfoot trefoil <i>Lotus corniculatus</i>	 Black medick <i>Medicago lupulina</i>	 Yellow woodsorrel <i>Oxalis stricta</i>	 Silverweeds <i>Argentina anserina</i>	 Silvery cinquefoil <i>Potentilla argentea</i>
 Rough cinquefoil <i>Potentilla norvegica</i>	 Perennial sow thistle <i>Sonchus arvensis</i>	 Yellow sweet clover <i>Melilotus officinalis</i>	 Lindley's aster <i>Symphyotrichum ciliolatum</i>	 Canada thistle <i>Cirsium arvense</i>
 Alfalfa <i>Medicago sativa</i>	 Pink yarrow <i>Achillea millifolium</i>	 Scentless chamomile <i>Matricaria perforata</i>		
 Scentless chamomile <i>Matricaria perforata</i>	 White yarrow <i>Achillea millifolium</i>	 White clover <i>Trifolium repens</i>	 Shepherd's purse <i>Capsella bursa-pastoris</i>	 Pink yarrow <i>Achillea millifolium</i>
 Absinthe <i>Artemisia absinthium</i>	 Lamb's quarters <i>Chenopodium album</i>	 Canada fleabane <i>Conyza canadensis</i>	 Kochia <i>Kochia scoparia</i>	 Special red color for Kochia in fall



3. Birds garden

The birds garden is formed by the plant species that can support the birds in the seeding season. At the same time, the fine texture of grassy 'weeds' would form a contrast with the rough texture of broad-leaved plants.



A notional birds garden Figure 5.39

 Green foxtail <i>Setaria viridis</i>	 Foxtail barley <i>Hordeum jubatum</i>	 Quackgrass <i>Elymus repens</i>
 Lamb's quarters <i>Chenopodium album</i>	 Oak-leaved goosefoot <i>Chenopodium glaucum</i>	 Perennial ragweed <i>Ambrosia psilostachya</i>
 Redroot pigweed <i>Amaranthus retroflexus</i>	 Broad-leaved plantain <i>Plantago major</i>	 Pineapple weed <i>Matricaria discoidea</i>
 Curly dock <i>Rumex crispus</i>	 Special red color for Curly dock in fall	



Concept of design - diagrammatic of space

1. Link space 0, space 1, space 2, space 3, birds garden and hedges to form the garden

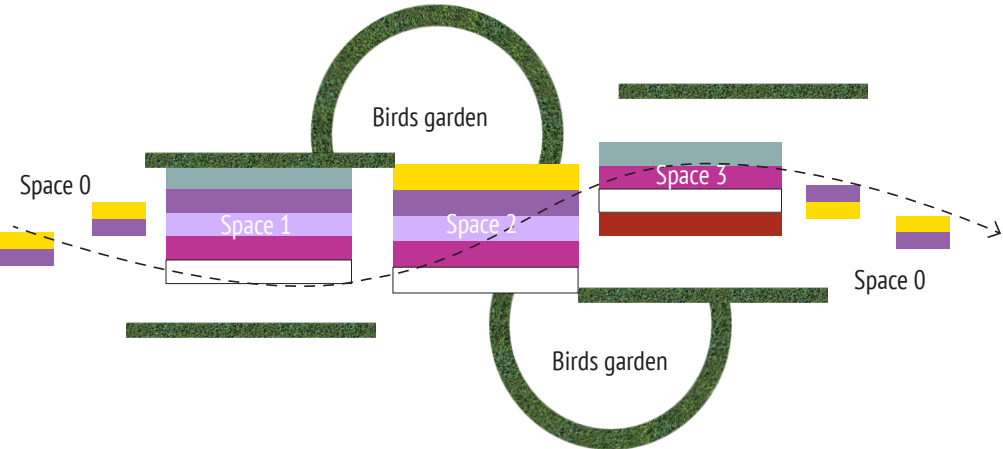


Figure 5.51

2. Wind direction for seeding time: wind direction distribution in %

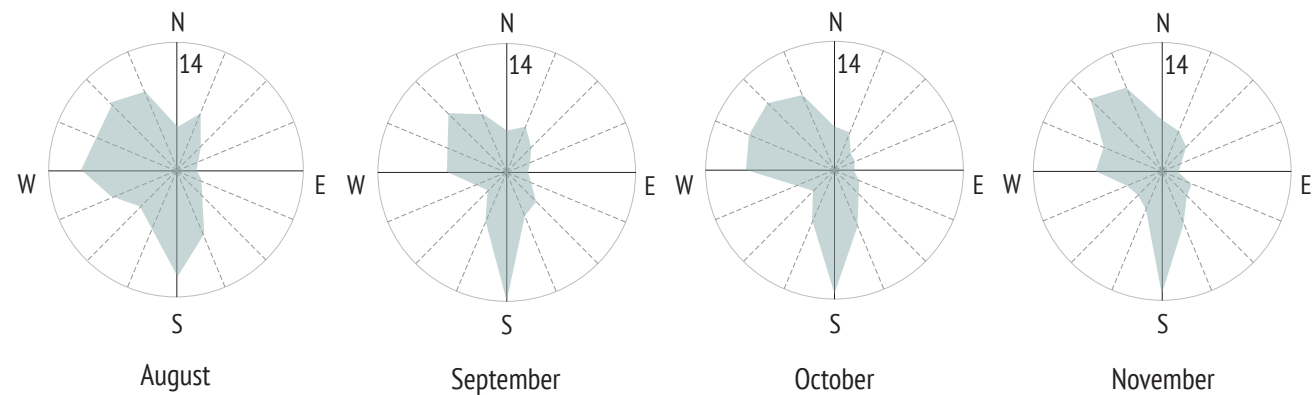


Figure 5.52

3. The re-orientation of the hedge direction according to the wind direction

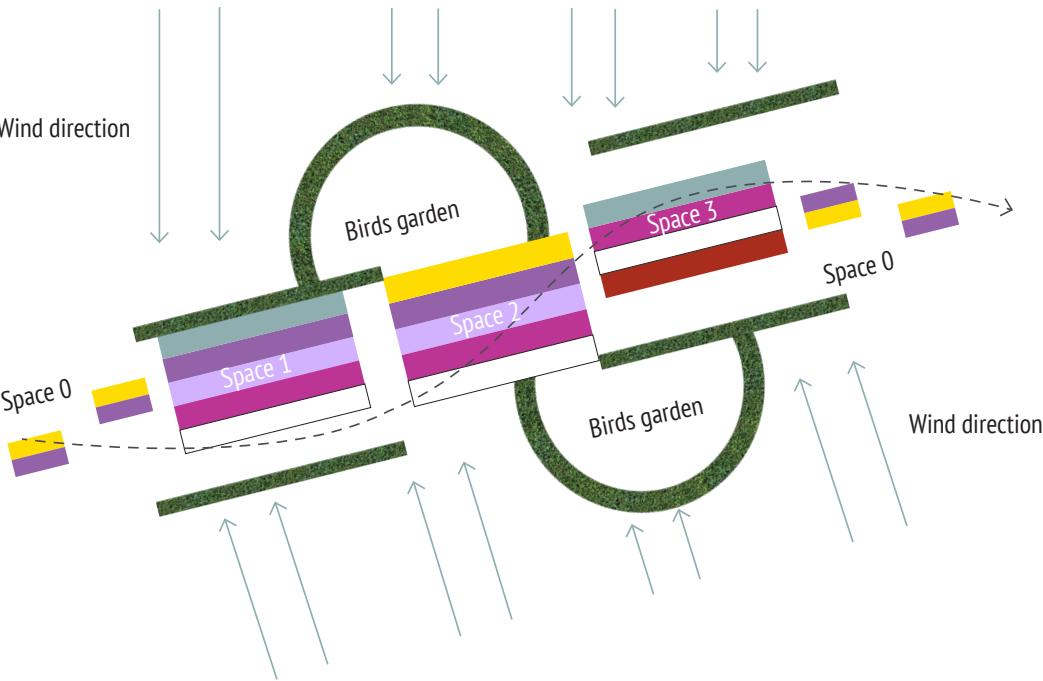


Figure 5.53

Site analysis after design

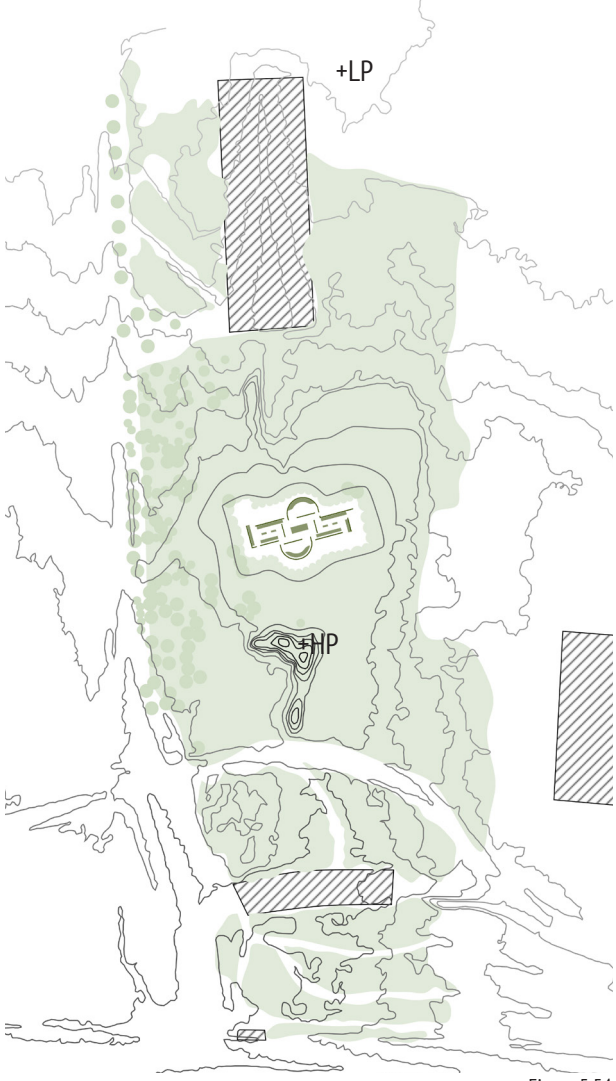


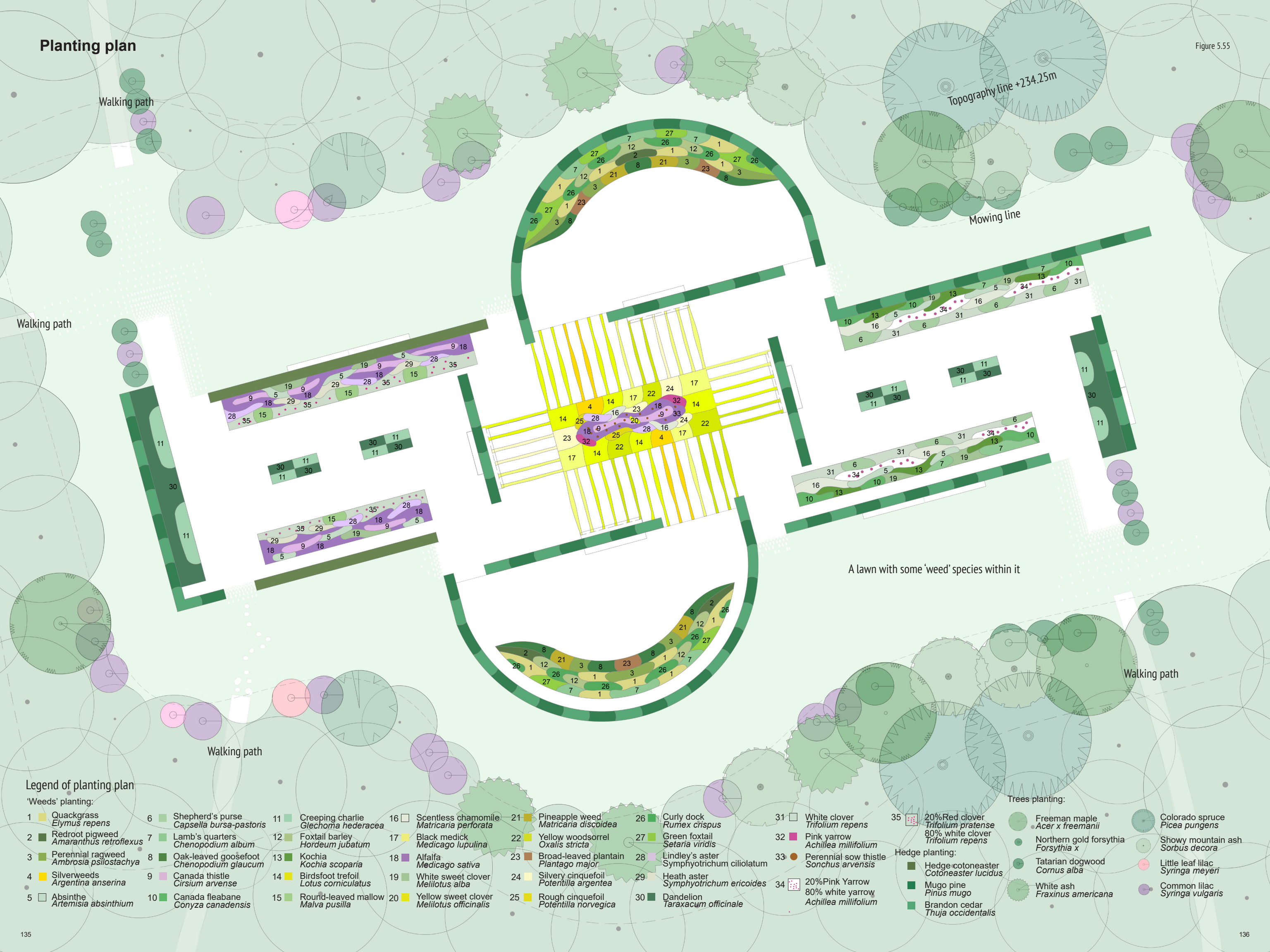
Figure 5.54

After the design, the site will plant more trees to intensify the dense cover of forest surrounding the garden.

This diagram illustrates the redesigned topography lines. To avoid the removing of existing trees, the topography lines under the forest cover aren't changed too much. The garden would be built on an 'almost' flat site as shown above.

Planting plan

Figure 5.55



Walking path

Topography line +234.25m

Mowing line

A lawn with some 'weed' species within it

Walking path

Walking path

Legend of planting plan

'Weeds' planting:

- 1 Quackgrass *Elymus repens*
- 2 Redroot pigweed *Amaranthus retroflexus*
- 3 Perennial ragweed *Ambrosia psilostachya*
- 4 Silverweeds *Argentina anserina*
- 5 Absinthe *Artemisia absinthium*

- 6 Shepherd's purse *Capsella bursa-pastoris*
- 7 Lamb's quarters *Chenopodium album*
- 8 Oak-leaved goosefoot *Chenopodium glaucum*
- 9 Canada thistle *Cirsium arvense*
- 10 Canada fleabane *Conyza canadensis*

- 11 Creeping charlie *Glechoma hederacea*
- 12 Foxtail barley *Hordeum jubatum*
- 13 Kochia *Kochia scoparia*
- 14 Birdsfoot trefoil *Lotus corniculatus*
- 15 Round-leaved mallow *Malva pusilla*

- 16 Scentless chamomile *Matricaria perforata*
- 17 Black medick *Medicago lupulina*
- 18 Alfalfa *Medicago sativa*
- 19 White sweet clover *Melilotus alba*
- 20 Yellow sweet clover *Melilotus officinalis*

- 21 Pineapple weed *Matricaria discoidea*
- 22 Yellow woodsorrel *Oxalis stricta*
- 23 Broad-leaved plantain *Plantago major*
- 24 Silvery cinquefoil *Potentilla argentea*
- 25 Rough cinquefoil *Potentilla norvegica*

- 26 Curly dock *Rumex crispus*
- 27 Green foxtail *Setaria viridis*
- 28 Lindley's aster *Symphotrichum ciliolatum*
- 29 Heath aster *Symphotrichum ericoides*
- 30 Dandelion *Taraxacum officinale*

- 31 White clover *Trifolium repens*
- 32 Pink yarrow *Achillea millefolium*
- 33 Perennial sow thistle *Sonchus arvensis*
- 34 20% Pink Yarrow 80% white yarrow *Achillea millefolium*

- 35 20% Red clover 80% white clover *Trifolium repens*
- Hedge planting:
- Hedge cotoneaster *Cotoneaster lucidus*
 - Mugo pine *Pinus mugo*
 - Brandon cedar *Thuja occidentalis*

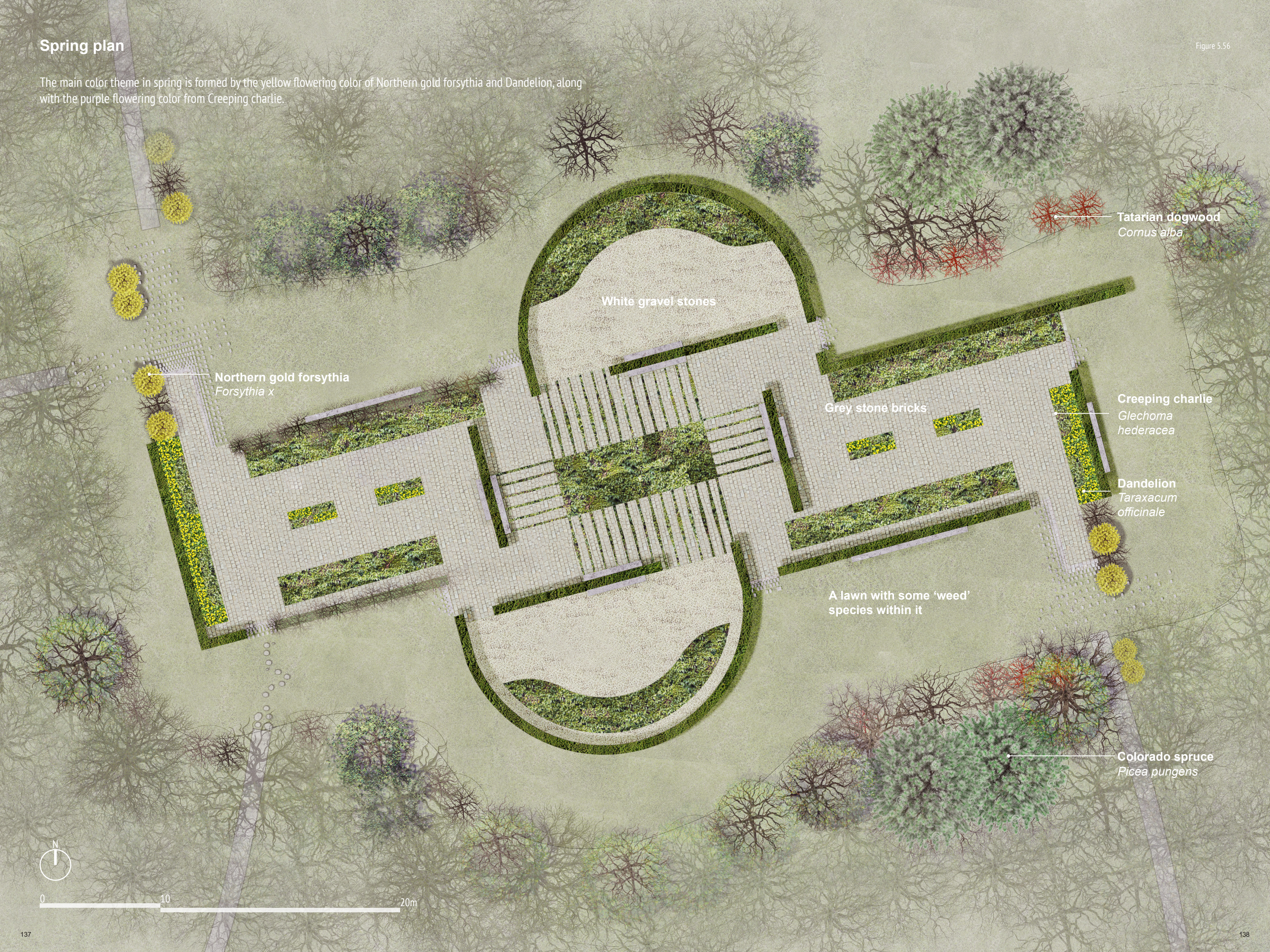
Trees planting:

- Freeman maple *Acer x freemanii*
- Northern gold forsythia *Forsythia x*
- Tatarian dogwood *Cornus alba*
- White ash *Fraxinus americana*
- Colorado spruce *Picea pungens*
- Showy mountain ash *Sorbus decora*
- Little leaf lilac *Syringa meyeri*
- Common lilac *Syringa vulgaris*

Spring plan

The main color theme in spring is formed by the yellow flowering color of Northern gold forsythia and Dandelion, along with the purple flowering color from Creeping charlie.

Figure 5.56



0 10 20m

Garden entrance in spring

The yellow flowering color of Northern gold forsythia outside the garden interacts with the yellow flowering color of Dandelion in the spring.

Figure 5.57



Space 0 in spring

Figure 5.58

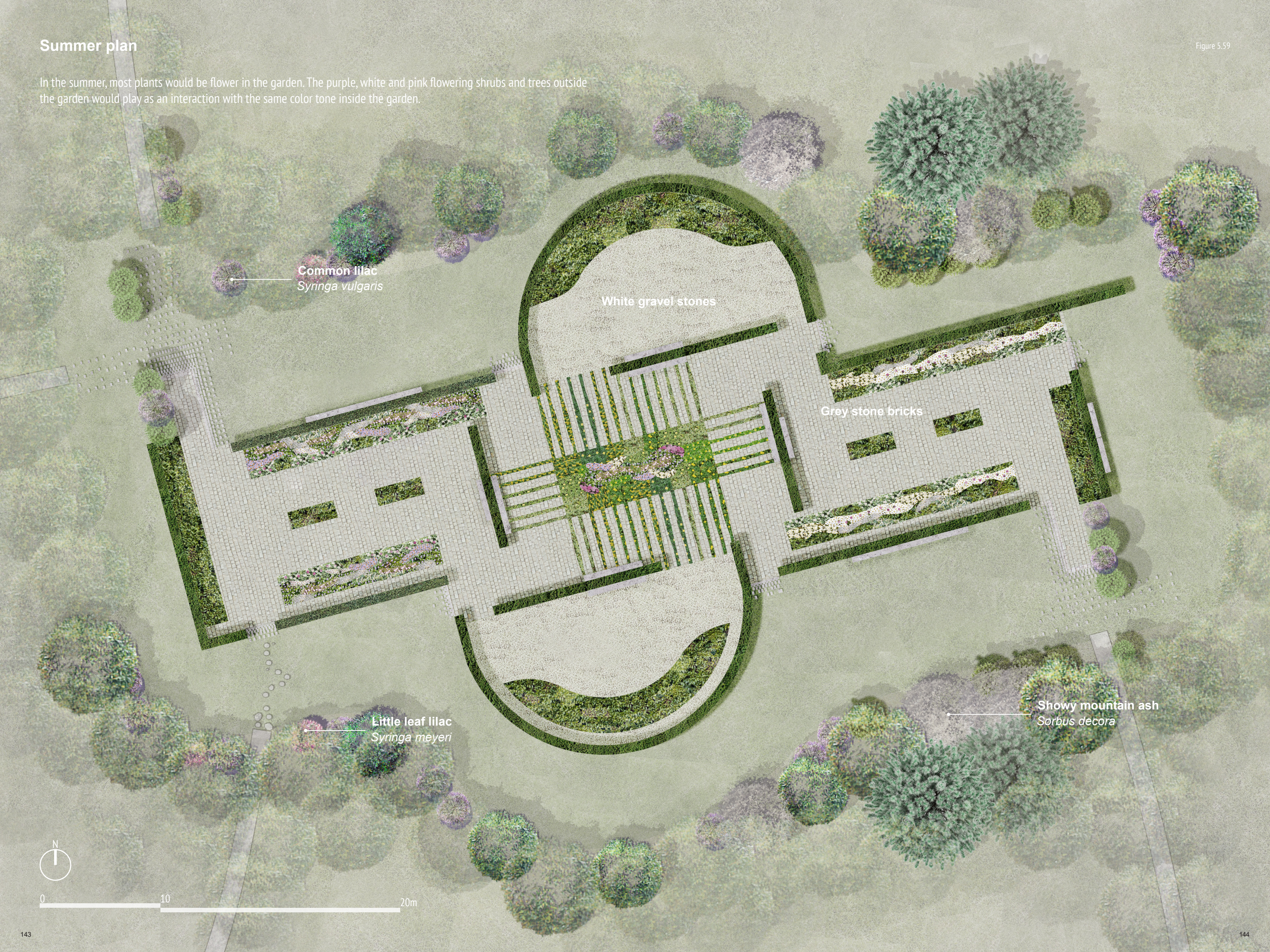
The yellow flowering color of Dandelion and the purple flowering color from Creeping charlie form the main color theme at the garden in spring.



Summer plan

Figure 5.59

In the summer, most plants would be flower in the garden. The purple, white and pink flowering shrubs and trees outside the garden would play as an interaction with the same color tone inside the garden.



Common lilac
Syringa vulgaris

White gravel stones

Grey stone bricks

Little leaf lilac
Syringa meyeri

Showy mountain ash
Sorbus decora



0 10 20m

Space 1 in summer

Figure 5.60

The color tone in the space one is a mix of grey-green, purple, white and a little bit of pink.



Space between the forest edge and the hedged garden in summer

Figure 5.61

The space outside the garden would play as an interaction with the same color tone inside the garden.



Space 2 in summer

Figure 5.62

The mix of yellow, purple, white and pink flowering color would form a bright color tone. The plants are supposed to spread in the brick slot that left purposefully.



Space 3 in summer

Figure 5.63

After visiting the bright color pattern in space 2, the cold color theme in space 3 would make people cool down.



Fall plan

The red color is the primary tone for the garden in fall.

Figure 5.64



Northern gold forsythia
Forsythia x

Cotoneaster
Cotoneaster lucidus

Little leaf lilac
Syringa meyeri

Showy mountain ash
Sorbus decora

Tatarian dogwood
Cornus alba

Kochia
Kochia scoparia

Curly dock
Rumex crispus

Freeman maple
Acer x freemanii

Colorado spruce
Picea pungens

White ash
Fraxinus americana



0 10 20m

Space 3 in fall

Figure 5.65

The red color from Kochia in the garden would highlight and emphasize the red color of Freeman maple outside the garden. At the same time, the red color of kochia would form a contrast with the grey-green color of Absinthe.



Birds garden in fall

Figure 5.66

The birds garden would attract many birds in the fall. The red color from Curly dock would interact, and highlight the red tones from the White ash outside.



Space between the forest edge and the hedged garden in fall

Figure 5.67

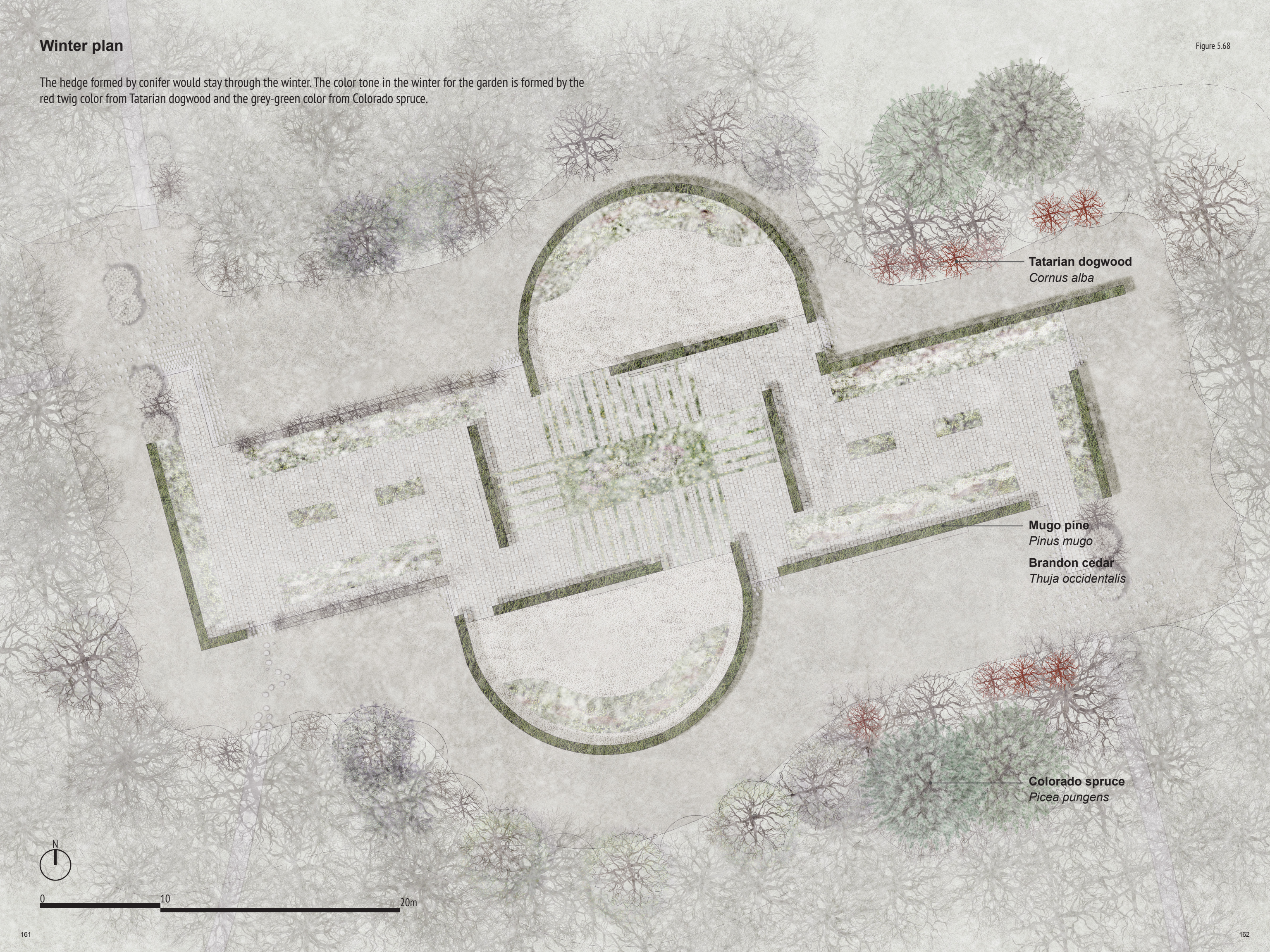
Not only would the red fruit of the Showy mountain ash play off the red foliage color of the Freeman maple, but it would also attract birds during fall and even winter.



Winter plan

The hedge formed by conifer would stay through the winter. The color tone in the winter for the garden is formed by the red twig color from Tatarian dogwood and the grey-green color from Colorado spruce.

Figure 5.68



Tatarian dogwood
Cornus alba

Mugo pine
Pinus mugo

Brandon cedar
Thuja occidentalis

Colorado spruce
Picea pungens



0 10 20m

Entrance space in winter

Figure 5.69

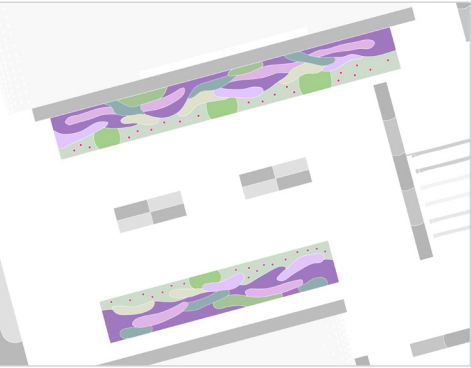
A winter view for the garden.



Management of the garden

The management rule of the garden is to keep the key color or texture pattern of the border instead of keeping plants in a strict planting area. Also, to avoid the further spread of the ‘weeds,’ which would influence the surrounding functional landscape of Assiniboine Park, it is anticipated that, after seeding, only 10% of the seeds on heads would remain for birds. Moreover, for educational purposes, all edible cut material would be sent to the LEAF kitchen in the Canada’s Diversity Garden.

Space 1



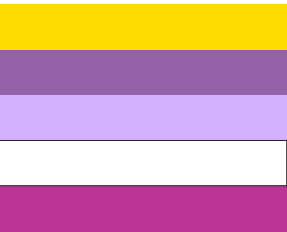
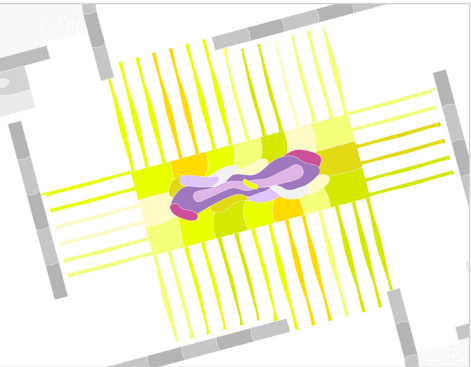
Color or texture pattern needed to keep



The purple, white and red-pink flowering plants, along with the grey-green color from Absinthe should be kept in the border.

Avoid the invasion of the yellow flowering plants and the plants in the birds garden. Once invaded, these plants should be eradicated.

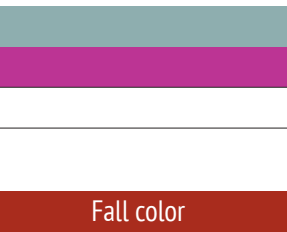
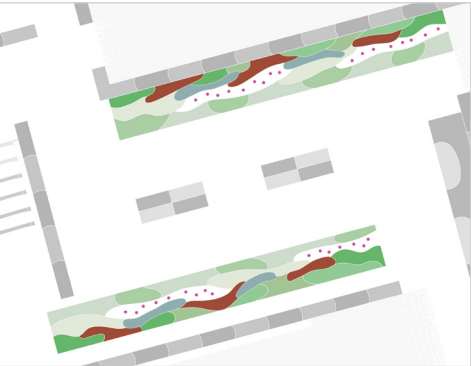
Space 2



The yellow, purple, white, and pink flowering plants should be kept in the border.

Avoid the invasion of the plants in the birds garden and Absinthe.

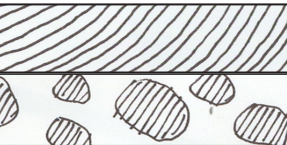
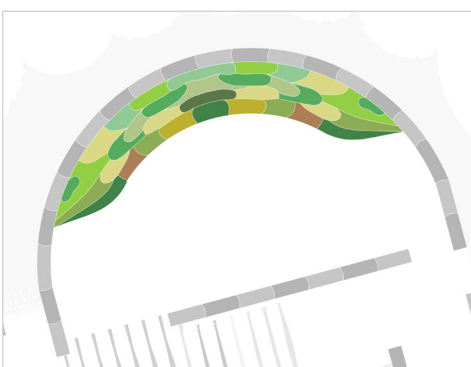
Space 3



The pink flowering plants and white flowering plants along with the grey-green color from Absinthe should be kept in the border.

Avoid the invasion of purple flowering plants, yellow flowering plants and the plants in the birds garden.

Birds garden



Keep the fine and the rough texture in the border at the bird garden.

Avoid the invasion of colorful flowering plants and Absinthe.

Figure 5.70

Predication of garden’s future

Most of these plants are quite prolific. If the garden is difficult to be maintained under the current management plan, this work contains a prediction of what might happen for the future of the garden. The competitive ability of these plants is classified as four levels. The plants in level four are most competitive, whereas the plants in level 1 are least.

Level 1: Short annual plants, reported successtional annual plants

Shepherd’s purse <i>Capsella bursa-pastoris</i>	Kochia <i>Kochia scoparia</i>	Yellow sweet clover <i>Melilotus officinalis</i>	Broad-leaved plantain <i>Plantago major</i>
Oak-leaved goosefoot <i>Chenopodium glaucum</i>	Scentless chamomile <i>Matricaria perforata</i>	White sweet clover <i>Melilotus alba</i>	Rough cinquefoil <i>Potentilla norvegica</i>
Round-leaved mallow <i>Malva pusilla</i>	Black medick <i>Medicago lupulina</i>	Pineapple weed <i>Matricaria discoidea</i>	Green foxtail <i>Setaria viridis</i>

Level 2:Tall annual plants, reported successtional perennial plants

Redroot pigweed <i>Amaranthus retroflexus</i>	Lamb’s quarters <i>Chenopodium album</i>	Canada fleabane <i>Conyza canadensis</i>	Perennial sow thistle <i>Sonchus arvensis</i>
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Level 3: Perennial plants only reproduced by seeds, short perennial plants reproduced by both seeds and roots

Silverweeds <i>Argentina anserina</i>	Foxtail barley <i>Hordeum jubatum</i>	Yellow woodsorrel <i>Oxalis stricta</i>	Red clover <i>Trifolium pratense</i>
Absinthe <i>Artemisia absinthium</i>	Birdsfoot trefoil <i>Lotus corniculatus</i>	Silvery cinquefoil <i>Potentilla argentea</i>	White clover <i>Trifolium repens</i>
Creeping Charlie <i>Glechoma hederacea</i>	Alfalfa <i>Medicago sativa</i>	Curly dock <i>Rumex crispus</i>	

Level 4: Tall perennial plants reproduced by both seeds and roots

Yarrow <i>Achillea millifolium</i>	Perennial ragweed <i>Ambrosia psilostachya</i>	Lindley’s aster <i>Symphyotrichum ciliolatum</i>	Dandelion <i>Taraxacum officinale</i>
Quackgrass <i>Elymus repens</i>	Canada thistle <i>Cirsium arvense</i>	Heath aster <i>Symphyotrichum ericoides</i>	

Predication of garden’s future

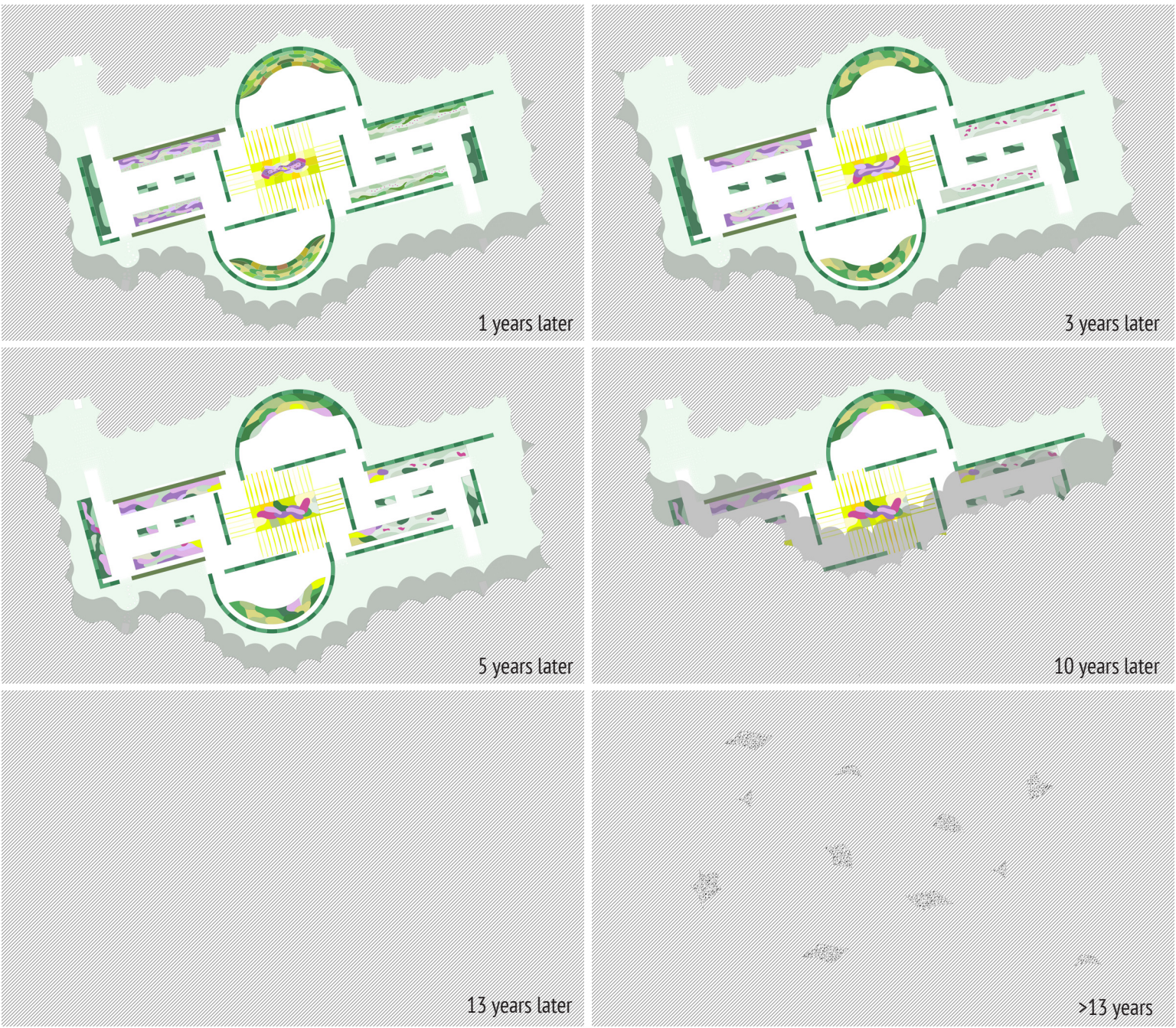


Figure 5.71

It is predicted three years later, the plants in level 1 and 2 would be first outcompeted in the border, but under the current management plan, the color pattern would still be kept in each border. Five years later, if the plants are so hard to be kept in the border, then the current management plan would be abandoned, in this way, the plants in different border would be mixed and the original color pattern wouldn't be kept anymore. Ten years later,

the garden would be invaded by the forest coming through the south part of the garden, as most of these plants are susceptible to shade, but much prefer the full or partial sun for growth. It is estimated 13 years later, the surrounding forest would fully replace the garden. And once the forest disturbed, these ruderal plants would show up again.

Conclusion

Even though it is hard to predict what is going to happen for the garden in the future, the project offers an opportunity to test the habits of these plant species. As world flora shift dramatically due to climate change, it is essential for people to learn the value of, and utilize these plants which may dominate our environments in the future. Let us start to treasure these lovely plants under our foot!

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