

# Plant Guilds

## Taking Companion Planting to the Next Level



Friends of the Farm Lecture Series

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- Plant guilds are both a relatively new concept and a very old idea.
- Early Europeans arriving on the eastern shores of North America commented on the beautiful, park-like forests (but not everywhere).
- That's because, for generations, some aboriginal peoples had practiced sustainable food forest gardening through selective planting, harvesting and clearing by burning
- Unfortunately none of those early settlers took the time to study these gardens.
- So today we are trying to relearn what plants go together harmoniously.
- This is still very much an evolving field of study and is generally considered an important part of the larger field of study called "permaculture".
  
- One other cautionary note is that permaculturists place high value on useful plants.
- Throughout this presentation, I may refer to plants having food or medicinal value. This is not meant as advice.
- You should do your own research and decide for yourself what unconventional plants you want to try eating, and use special caution when trying them for yourself.
- You should also never try home-made herbal remedies without first seeking professional advice.

## Outline

1. Some Definitions
2. Plant Guilds versus Companion Planting
3. From “Babying the Garden” to a Mature Ecosystem
4. Two Multi-Talented Plants
  - White oak (*Quercus alba*)
  - Comfrey (*Symphytum* spp.)
5. Plant functions in the garden ecosystem
6. Examples of plant guilds
7. Putting the pieces together:
  - Connections, Patterns and Zones
8. Q&A



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## 1a. Some Definitions

### Companion Planting

- the close planting of different plants to enhance each other's growth or protect each other from pests.
- planting different crops in proximity for pest control, pollination, providing habitat for beneficial creatures, maximizing use of space, and to otherwise increase crop productivity.

### Plant Guilds

- a grouping a plants, animals, insects, and other natural components that work together to help ensure their survival.
- any group of plants which support each other while growing near each other.



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### Plant Guilds defined by Wikipedia

- any group of species that exploit the same resources, often in related ways
- defined according to the locations, the attributes, and the activities of their component species

## 1b. Some Definitions

### Permaculture Defined

- The development of agricultural ecosystems intended to be sustainable and self-sufficient.
- The conscious design and maintenance of agriculturally productive systems which have the diversity, stability, and resilience of natural ecosystems.

### Permaculture Ethics

- People Care
- Earth Care
- Fair Share



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## Permaculture

- First coined by Australians David Holmgren, then a graduate student, and his professor, Bill Mollison, in 1978.
- The word permaculture originally referred to "permanent agriculture", [1] but was expanded to also mean "permanent culture", as it was understood that social aspects were integral to a truly sustainable system.

## 2. Plant Guilds versus Companion Planting

Dimension	Companion Planting	Plant Guilds
<b>Time</b>	<ul style="list-style-type: none"> <li>• Usually annual plants</li> <li>• For a single year</li> <li>• Can be changed each year</li> </ul>	<ul style="list-style-type: none"> <li>• Mostly perennial plants</li> <li>• Many years / decades</li> <li>• Key perennial / woody species persist over years</li> </ul>
<b>Complexity</b>	<ul style="list-style-type: none"> <li>• 2-3 plants</li> <li>• Provide few ecological functions</li> </ul>	<ul style="list-style-type: none"> <li>• Multiple species of plants</li> <li>• Fill many ecological niches</li> <li>• Becomes more complex over time</li> </ul>
<b>Philosophical context</b>	<ul style="list-style-type: none"> <li>• Organic growing</li> </ul>	<ul style="list-style-type: none"> <li>• Permaculture</li> </ul>
<b>Aesthetics</b>	<ul style="list-style-type: none"> <li>• Relatively neat and constrained</li> </ul>	<ul style="list-style-type: none"> <li>• Relatively messy and apparently “chaotic”</li> </ul>



## 2. Plant Guilds versus Companion Planting

Dimension	Companion Planting	Plant Guilds
Objectives	<ul style="list-style-type: none"><li>• Minimize harm</li><li>• Avoid competition for space &amp; resources</li><li>• Reduce build-up of pests and diseases</li><li>• Create positive environment (e.g., Attract beneficial insects, fix nitrogen, provide shade or support)</li></ul>	<ul style="list-style-type: none"><li>• Minimize inputs and throughputs to create abundantly productive, self-sustaining ecosystem</li><li>• <b>The ultimate goal is to create a “closed-loop” system.</b></li></ul>



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- **The ultimate goal of planting in guilds is to create a “closed-loop” system that minimizes inputs – both the gardener’s and nature’s, while producing abundantly.**

## 2. Plant Guilds versus Companion Planting

Dimension	Companion Planting	Plant Guilds
<b>Productivity ROI</b>	<ul style="list-style-type: none"> <li>• About 1:1</li> <li>• Productivity for conventional agriculture is 1:0.1</li> <li>• Declines over time</li> </ul>	<ul style="list-style-type: none"> <li>• &gt; 1:50</li> <li>• Increases over time</li> </ul>
<b>Environmental impact</b>	<ul style="list-style-type: none"> <li>• Minimally negative – does little harm, but still requires inputs and creates some waste</li> </ul>	<ul style="list-style-type: none"> <li>• Positive – contributes services to ecosystem, including wildlife habitat, carbon sequestration, etc.</li> </ul>



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- The productivity numbers are shown as inputs to outputs.
- The productivity numbers for permaculture are largely a guess. Some proponents claim the ROI for a mature food forest garden might be as high as 1:500.

### 3. From “Babying the Garden” to a Mature Ecosystem



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- We baby our gardens
- And that’s not really a good thing
- It means more work for us,
- It also means less productivity from the garden
  
- We tend to want to maintain our gardens as something resembling a plain, prairie or savannah – all of which are relatively stripped-down and immature eco-systems.
- Grasslands can be biodiverse mature ecosystems when many species are allowed to flourish but that’s not usually the case for our lawns.
  
- Now please close your eyes and imagine a vacant lot...
- It might start out looking a bit like this... Mostly empty, with just a few pioneer weeds.

### 3. From “Babying the Garden” to a Mature Ecosystem



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- After a year or so, it might start to look like this
- Annual weeds are moving in, pushing their way through the hard-pan and the asphalt
- After a couple of years, we start to see perennial weeds – bigger, tougher plants move in

### 3. From “Babying the Garden” to a Mature Ecosystem



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- After a few more years, we start to see the woodies moving in
- Those early pioneer weeds have decomposed, creating a thin layer of top-soil
- Tree seeds blow in and find a place to take root
- This transition is part of the natural maturation cycle of an ecosystem
- When we plant in guilds and practice permaculture, we recognize and respect this natural order of succession
- We expect our gardens to change over time, rather than working to keep them looking more or less the same year after year.
- The result is a more natural and dynamic ecosystem, and less work for the gardener!
  
- Before we start to think about combining multiple plants, let's consider how many functions a single plant can fill in the environment.

## 4a. Multi-Talented Plants: White Oak



- Our first example is *Quercus alba*, the native white oak.

### What functions does this tree play in /what services does it offer the landscape?

- Shade
- Differential temperatures between different levels of the tree create cooling breezes
- Offers habitat, food and shelter for birds, insects, other wildlife
- Water cycling – a mature oak can transpire up to 2000 gallons of water on a hot, dry day
- Dust, pollen and other particles arising from the leaves act to actually seed clouds
- Shade helps to retain water in the soil, roots also retain water
- Roots also stabilize soil
- And attract and sustain beneficial soil organisms such as mycorrhiza (Note: certain mycorrhizae are essential for *Quercus* spp.)
- Carbon and oxygen cycling
- Air purification – a mature oak may have 10-30 acres of leaf surface that traps dust and other air-borne particles
- Soil enrichment through continuous shedding of pollen, dust, mold spores, manure (from perching birds, etc.), small branches and leaves

- Acorns are also a traditional food for First Peoples of North America



### What about the functions / services offered by a more humble herbaceous perennial – Comfrey

- *Symphytum officinale* L.<sup>1</sup> Plant Family: *Boraginaceae*
- Plant has been used medicinally for centuries. Illustrations appear in Basil Besler's "Hortus Eystettensis", the earliest large folio of botanical info, published at Eichstatt near Nuremburg, in 1613
- Traditionally known as "knitbone", comfrey was thought to speed healing
- It contains the chemical allantoin, which is a proven anti-inflammatory. Allantoin is also commonly used in cosmetics, especially skin creams, and has been named in over 10,000 patents, mostly medicinal or cosmetic.
- The small mauve-blue flowers attract bees and other pollinators
- The large, fuzzy leaves are abundant and make excellent mulch material.
- While the fleshy roots delve deep into the soil, breaking up hard-pan and accessing nutrients such as potassium (K), Calcium (Ca) and magnesium (Mg) – all essential nutrients for plant growth and development
- The leaves have been used, even recently, as cattle fodder as they contain 35% protein. (Apparently the cattle don't much like comfrey but will eat it when there's nothing else.)
- **Caution:**
  - Internal use is discouraged because the plant also contains toxic alkaloids.
  - Also should not be used either internally or externally by pregnant women.
  - Timing of harvest is also important. Concentration of harmful alkaloids is greatest in early spring and in the roots.
  - This plant can be invasive. Although the flowers are often infertile, new plants can grow from even a small section of root.

## 5a.Plant Functions: Mulch Makers

### Characteristics

- Fast-growing
- “Messy” plants that drop litter
- Abundant soft leaves
- Rapid decomposition
- Serve other purposes
- **Not** allelopathic (e.g., walnuts, sunflowers)

### Examples

- Comfrey (*Symphytum* spp.)
- Beans (*Phaseolus* spp.)
- Nasturtiums (*Tropaeolum* spp.)
- Virginia creeper (*Parthenocissus quinquefolia*)
- Leafy weeds, e.g., burdock, plantain, red clover, mallow
- Aquatic plants (e.g., cattails, duckweed)



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### What other benefits do these plants offer?

- Beans?
  - Fix nitrogen
  - Have food value
- Nasturtiums?
  - Useful herb – food value
  - Ornamental
  - Trap crop for pests such as aphids and earwigs
  - Repel whiteflies and squash beetles
- Virginia creeper?
  - Screen plant
  - Insectary
  - Food and shelter for animals and birds
  - Gorgeous fall colour
  - Medicinal?

## 5b. Plant Functions: Nutrient Accumulators

### Characteristics

- Pioneer species
- Often classified as weeds
- May have deep tap roots, or
- Diffuse fibrous roots
- Draw nutrients up from subsoil

### Examples

- Yarrow (*Achillea millefolium*)
- Chamomile (German *Matricaria chamomilla*; or garden variety *Chamaemelum nobile*)
- Fennel (*Foeniculum vulgare*)
- Lamb's quarters (*Chenopodium album*)
- Chicory (*Cichorium intybus*)
- Dandelion (*Taraxacum* spp.)
- Plantain (*Plantago* spp.)<sub>14</sub>



## 5c.Plant Functions: N-Fixing

### Characteristics

- Plants that harbour bacteria or fungi among their roots that extract nitrogen from the air and convert it to a form useable by other plants
- Includes many legumes
- And some trees

### Examples

- Beans
- Peas
- Clover
- False indigo (*Baptisia australis*)
- Siberian pea shrub (*Caragana arborescens*)
- Locust trees (*Gleditsia* spp.)
- Russian olive (*Elaeagnus angustifolia*) **Invasive?**



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•Spelling: Caragana

•Russian Olive is now considered to be potentially to actually invasive

## 5d. Plant Functions: Soil Fumigants & Pest Repellants

### Characteristics

- Plants that secrete substances that discourage infestation either in the soil or living just above soil level.
- **Note:** this is not a well-researched area
- Plant in limited numbers

### Examples

- Nasturtium (whitefly)
- False indigo
- Marigolds (soil nematodes)



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•I think that you want to say ‘secrete substances that discourage infestation’

## 5e.Plant Functions: Insectaries

### Characteristics

- Fragrant flowers
- Blooms rich in pollen or nectar
- Some night-blooming species
- Early and late season blooms
- **Note:** two kinds of beneficial insects – pollinators and predators



### Examples – Pollinators

- Yarrow
- Buckwheat
- Lamiaceae family (lavender, mint, bee balm)
- Many clovers
- Liliaceae family
- Asteraceae (Compositae) family – daisies, sunflowers

### Examples: Predators

- Apiaceae (Umbelliferae) family (carrots, dill, fennel, Queen Anne's lace, cilantro)

## 5f. Plant Functions: Barrier Plants

### Characteristics

- Dense growth above or below ground blocks aggressive plants
- Blocks wind (AKA shelter-belters)
- Visual or functional “wall” to block sight-lines or animals / people



### Examples – Growth Block

- Violets
- Jerusalem artichoke
- Sunflower (allelopathic)
- Big root geranium

### Examples – Wind Breaks

- “Fedges” – fruit or food hedge of edible plants
- Cedar, hazelnut, Nanking cherry, lilac, etc.

### Examples – Living Walls

- Devil's Walkingstick (*Aralia spinosa*), thistles
- Tall ornamental grasses, dense vines

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- Prevent spread of invasive plants
- Provide shelter from wind
- Create visual or functional “wall”

## 5g. Plant Functions: Wildlife Nurturers

### Characteristics

- Plants that offer food, shelter, nesting materials, or nest sites

### Examples

- See backyard habitat requirements from Canadian Wildlife Federation
- Nectar plants, fruit, nut and seed-bearing natives
- Evergreens, dense or thorny plants for shelter
- Grasses
- Wood piles, ground litter
- Hollow trees, “nurse logs”



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- Incorporating more native plants will help to bring in wildlife
- Eliminating chemicals from the garden – including chemical fertilizers, is helpful
- Often the key to attracting wildlife is things you don't do, more than things you do or plant
  - Not cleaning everything up in the fall allows insect larvae to winter over in standing plants that have hollow stems
  - Not cleaning up plant litter leaves spaces for toads and other critters to shelter in cooler weather

## 5i. Plant Functions: Plants for Human Use

### Characteristics

- Food
- Medicinal use
- Fuel
- Craft materials
- Aesthetics – all the pretty things we like to grow...



### Examples – Food

- Many choices -- annuals, perennials, herbaceous, woody, vines

### Examples – Medicine

- Some herbs, tree bark, flowers – Caution!!

### Examples – Fuel

- Fast-growing wood for coppicing – willow

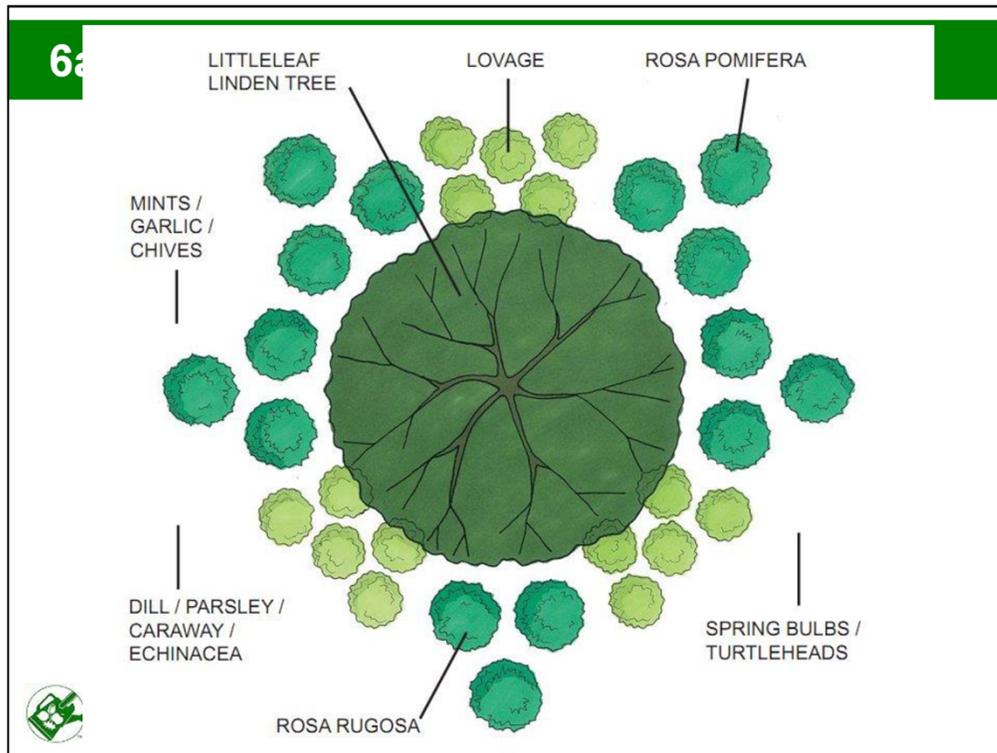
### Examples – Crafting

- Grape vines, flowers for drying, coppice-wood for whittling

- Food
- Medicinal use
- Fuel
- Craft materials
- Aesthetics



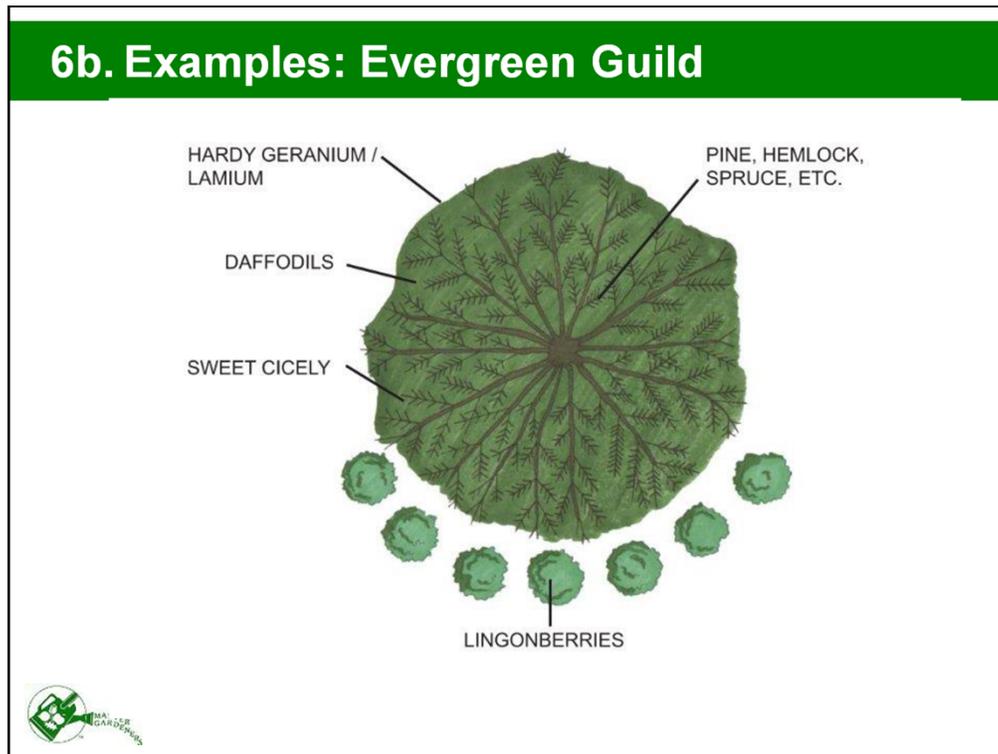
- Here's a rather lumpy Christmas wreath I made with the vines pruned from my grapes



- The following four examples of guilds come from a free e-book written by Bryce Ruddock and available through Midwest Permaculture
- The **Bee Guild** is designed to attract pollinators
- Any substitutions of surrounding plant material should consider pollinators' needs for continuous blooms throughout the growing season.
- North is at the top
- Space required it about 10 meters diameter
- The centre point of the guild is littleleaf Linden (*Tilia cordata*):
  - Non-native
  - Compact pyramidal shape
  - Tolerant of pollution
  - Lovely fragrant flowers in July attract many pollinators
  - Linden flower tea considered valuable as an anti-inflammatory and for respiratory problems.
  - Young leaves can be eaten as a salad green
- Rosa pomifera (AKA Rosa villosa) may not be fully hardy
- Rosa woodsii or a pavement rose could be used instead. The latter are much

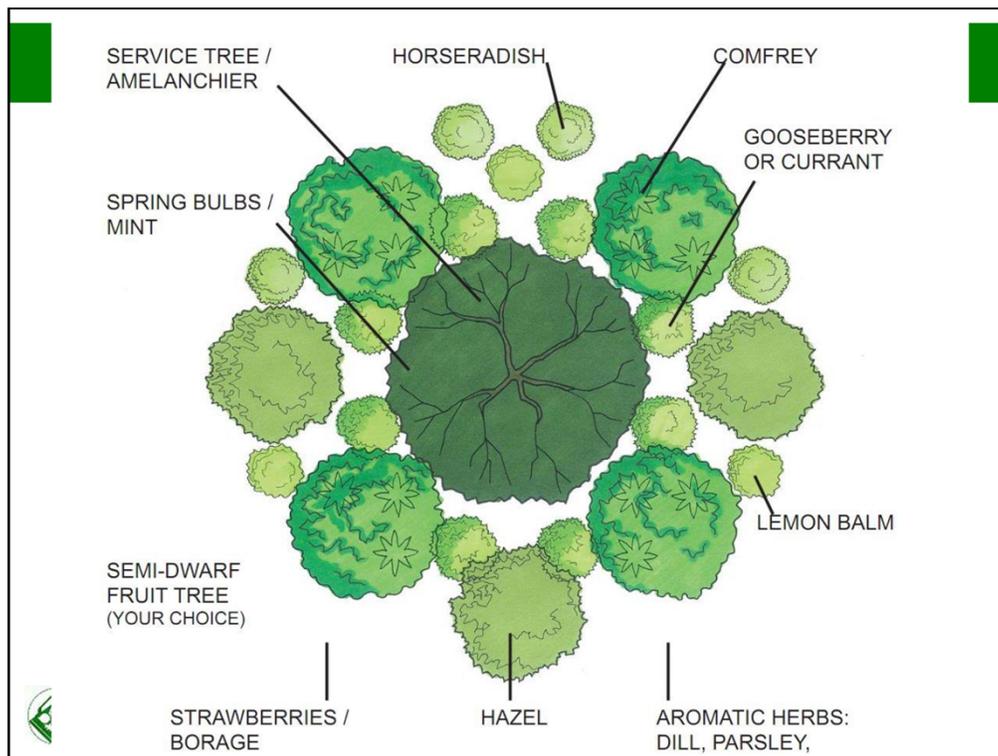
shorter and would not provide as much shelter as Woodsii.

## 6b. Examples: Evergreen Guild



- Once again, North is at the top
- Space required is also about 10 meters diameter
- The lingonberries are hardy in our climate, but require fairly acidic soil
- Much of Ottawa is on calcareous bedrock, so we tend to have quite sweet (alkaline) soil. The presence of a nearby evergreen is not enough to lower pH from 7 to 5, which is what lingonberries typically like.
- Plants that provide comparable benefits and would work include:
  - Haskaps
  - Nanking cherry – for which you need at least two for good production
  - Currant bushes
  - Gooseberries
- Note fruit bushes are on the south side and beyond the drip line of the evergreens.
- Also note this planting scheme doesn't call for anything on the north or east sides of the evergreens because those locations would not get enough light.
- So how about the functions of this grouping?
  - Most conifer needles can be brewed up into a tea rich in vitamin C that traditionally kept First Peoples and pioneers from getting scurvy during our long winters.
  - The hardy geranium has medicinal use as an astringent and is an easy-care, long-blooming perennial
  - Sweet cicely (*Myrrhis odorata*) is a perennial European herb that has both edible and medicinal properties, as well as a very pretty white flower in spring.
- If nothing else, this planting combination should provide inspiration for anyone

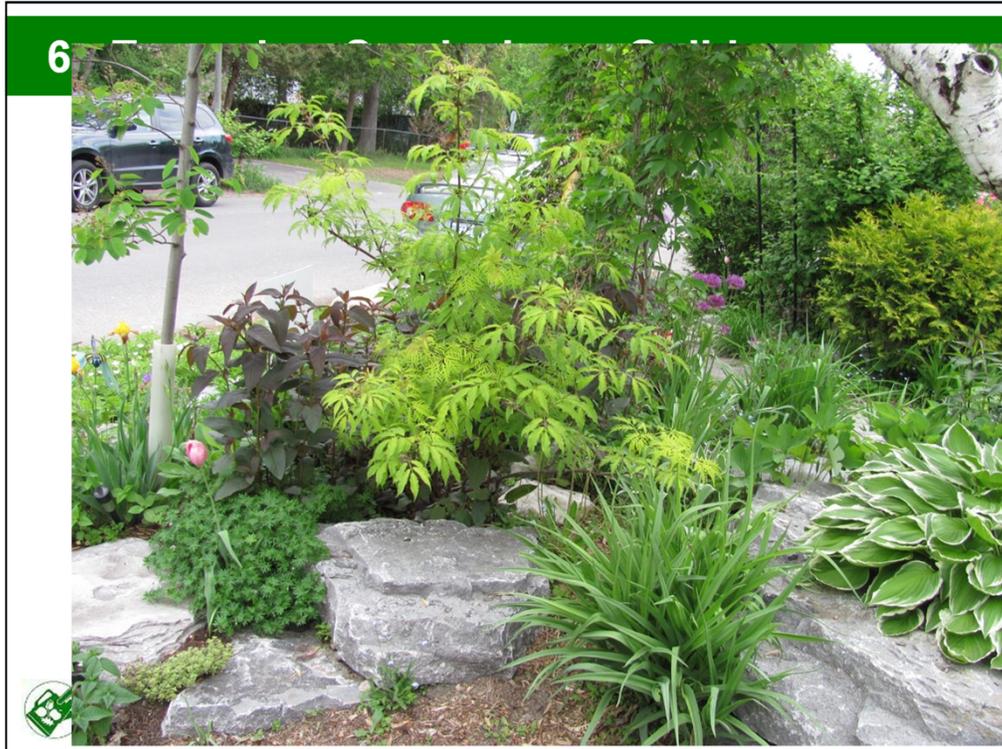
burdened with an abundance of evergreens and a deficit of colour!



## Serviceberry Guild

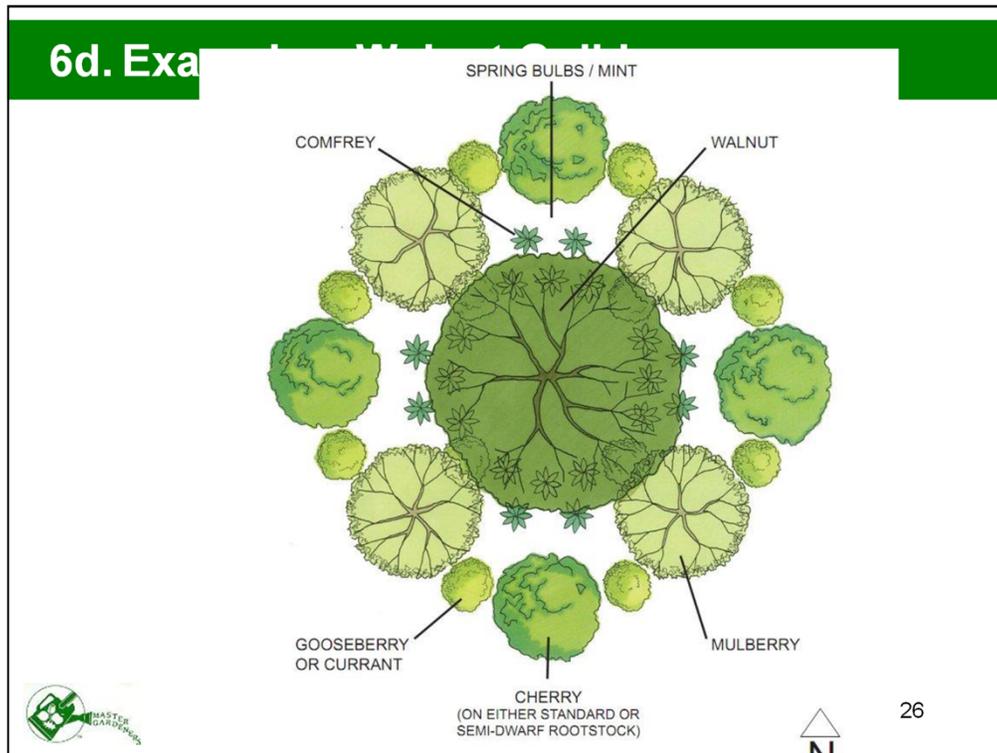
- Again north is at the top of this image
- The diameter of this grouping can range from 6 to 15 metres.
- The central plant in this guild is an Amelanchier, and there are several varieties that are hardy to our area. However, *Amelanchier canadensis* is the one most commonly used.
- You may have noticed that serviceberries (*Amelanchier* spp.) have become a very popular urban tree in Ottawa.
- Now that plant breeders have produced reliably single-stemmed varieties, it's not hard to understand the popularity.
- This really is a small tree with 4-season interest – lovely early spring blooms, delicious fruit resembling blueberries in mid-summer, beautiful fall colours and attractive smooth bark and branching structure for winter interest.
- Note, you need two different hazelnut cultivars to produce nuts.
- You also have to be very vigilant to get either fruit or nuts because otherwise the wildlife is likely to get there first!
- This scheme also suggests adding dwarf fruit trees such as apples or pears. Again, make sure you know the pollination requirements before you plant. Breeders are increasingly making these fruit trees self-fertile, but ask before you buy just one!
- In a smaller space, you might prefer to use only small bushes, like the currant bushes recommended for the North side of this grouping.
- The open canopy of these deciduous trees and shrubs may also allow you to plant in 3-dimensions with vines – either perennials, such as grapes or hardy kiwis; or annuals like peas or beans, which will also add nitrogen.
- The comfrey and horseradish are both deep-rooted plants that will help to pull nutrients from the sub-soil.
- Spring bulbs add full-season interest but also bring in early season pollinators who will be needed when your fruit and nut trees start to bloom.

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- This picture taken in my front yard in May 2015 illustrates one of the challenges of planting in guilds.
- Very few of us start with a clean slate.
- In this case, this bed was renovated and replanted in July 2012.
- My research into permaculture was just beginning and I had a very incomplete understanding of plant guilds.
- Plus, after having all my plants in pots for months, and this being a very hot dry year, I just wanted to get things back into the ground.
- As a result, I mostly considered space requirements and aesthetics.
- The elderberry in the foreground has beautiful chartreuse leaves that contrasts really well with purple-leaved *Lysimachia ciliata* next to it. And the elderberry fit into that space beside the serviceberry.
- Unfortunately, a few years later, I am concluding that they don't much like each other. The serviceberry does OK but the elderberry seems to lose its flowers without producing fruit.
- The other plantings near the serviceberry include:
  - Bearded irises
  - Tradescantia
  - Alliums
  - Hostas
  - Canadian anemones
  - And yes, I do have mint and spring bulbs on the NW side – so at least I got

part of the combo right!



## Walnut Guild

- This guild applies to any member of the Juglans clan, including black walnuts, heartnuts and butternuts and also to hickories (*Carya* spp.)
- All these species are allelopathic and can be challenging because the toxins they exude damage or kill many other species
- The chemical influence of the central tree in this guild can extend at least 50% past the drip-line.
- The space requirements of this guild are somewhat dependent on what you choose as the central tree. Black walnuts are slow-growing but can become large, majestic trees over time.
- They also have great value for their edible nuts, wood, dyes and ability to attract and shelter wildlife.
- Butternuts are typically more compact but are threatened by butternut canker, a nasty invasive fungus that can kill a healthy tree in very short order.
- Sweet cherries are not hardy in our area, but a number of sour cherry cultivars are. (e.g., *Prunus cerasus*)
- In addition to the gooseberry and currant bushes shown here, raspberries are also tolerant of Juglone and might work better in a tight spot.
- There is actually a surprising diversity of plants that are juglone tolerant, including:
  - Ajuga; Heucheras; Daylilies; Daffodils; Hostas; Phlox; Primrose and
  - Fiddle-head ferns, which are also edible
- Lists of juglone tolerant plants are available on line, including on OMAFRA's website

## 7a. Putting the Pieces Together: Connections

### Connections

- Well-placed garden elements create synergy.
- Each piece plays many roles and
- Each role is supported by many players.



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- Another way to look at this is to consider redundancies for the most important functions in your garden.
- For example, water is crucial
- How many ways can you first keep water, and then bring in supplemental water if required?
- Strategies for keeping water include:
  - Mulch garden beds
  - Install rain barrels
  - If your property is sloped, consider building swales (catchment ditches that redirect water to areas where it's needed)
  - Eliminate as many hard surfaces as possible to prevent run-off – e.g., building a rain garden, or replacing a driveway with a country lane.
- Strategies for bringing in water might include:
  - Municipal water supplies
  - Recycling grey water
  - A pond to serve for emergencies
  - If you're lucky, you might also live enough to near a stream, river or lake that you could actually carry buckets of water in an emergency.

## 7b. Putting the Pieces Together: Patterns



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### Patterns

- Keeping in mind the objective of creating a functional ecosystem in our gardens, we want to observe and replicate natural patterns.
- These are examples of one kind of pattern... What is the common pattern here?
- Spirals
  - snail shell, ram's horn, fern frond before opening, twining vines

## 7b. Putting the Pieces Together: Patterns



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### Branching Patterns

- Observe and replicate natural patterns
- Branching
  - leaf veins, trees, roots, river systems

## 7b. Putting the Pieces Together: Patterns

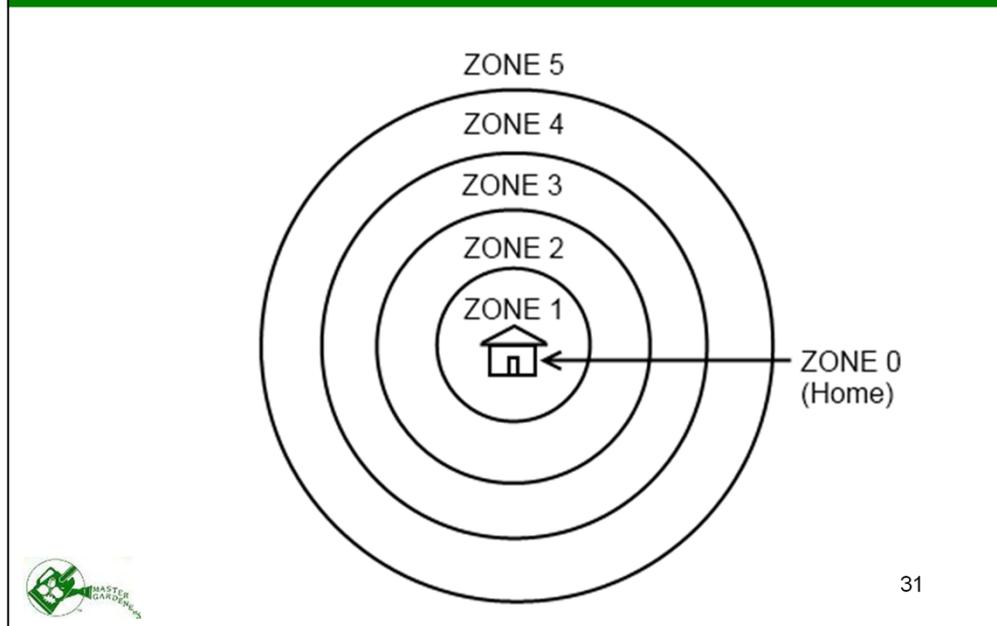


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### Net or Mesh Patterns

- Observe and replicate natural patterns
- Net or mesh
  - Spider web, honeycomb, wasps nests, cracking of dried mud.
- Other patterns include:
  - Bilateral symmetry – as in most vertebrates
  - Five-fold symmetry – as in many plants, star fish and silver dollars
  - Waves
  - Concentric circles
- All these natural patterns can provide inspiration for the layout and design of a garden, including:
  - How to arrange plants
  - Where to place paths and hard-scaping.

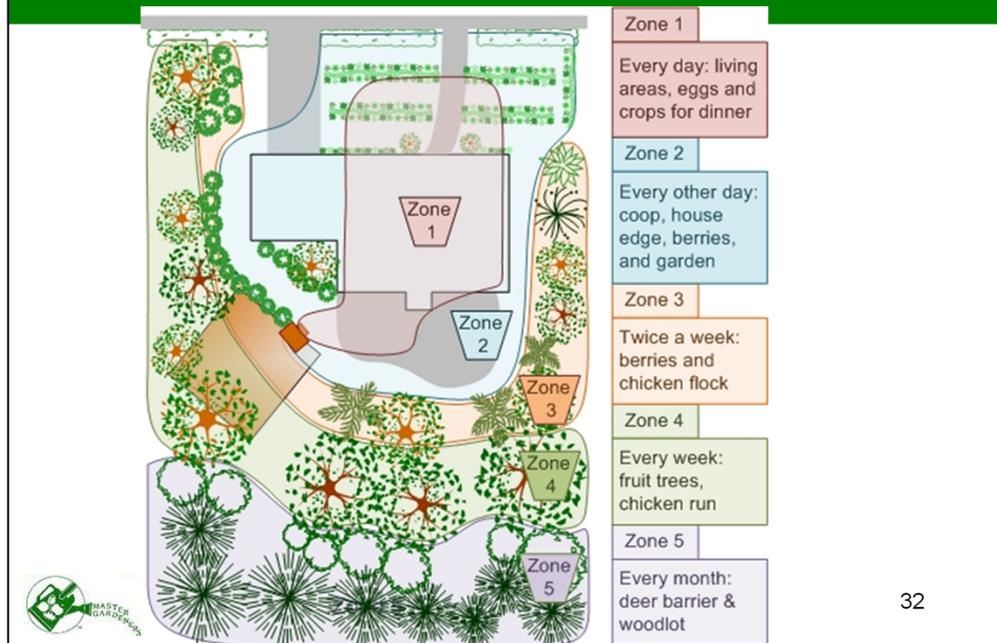
## 7c. Putting the Pieces Together: Zones



### Zones:

- In this case mean proximity, rather than hardiness
- The underlying pattern here is one of concentric circles
- Above is a very simple representation, courtesy of <http://deepgreenpermaculture.com/>

## 7c. Putting the Pieces Together: Zones



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### Zones:

- Here is an illustration of how you might populate the zones in a larger suburban garden
- In smaller gardens, you may not have a zone 4 or zone 5
- However, the overall principle is still useful. You can minimize your effort and labour by placing plants that you use most often, and those which require the most frequent attention closest to your home
- Image courtesy of the blog "And the Plot Thickens"  
(<http://www.andtheplothickens.net/2010/05/permaculture-zones/>)

## 7c. Putting the Pieces Together: Zones



### Zones:

- This is a personal example
- It's the view from my kitchen window
- Having those lilies nearby means I can easily check for the dreaded lily beetle
- The view of the pond is soothing, but I also need to check regularly to make sure the pump is working and the water is at the right level in the pond. This view lets me see that everything is OK without even having to step outside.
- Not visible in this photo is a small bed just underneath the window where I grow several useful herbs that can be easily accessed from the back door.

## 8. Questions



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- I hope this presentation has whetted your appetite to find out more about plant guilds and sustainable gardening strategies
- There are lots and lots of resources on line, including really useful free eBooks and how-to videos

## 12. Questions? / Discussion

### Master Gardeners of Ottawa-Carleton

Questions on zone 4a thru 5b only please.

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