

**Increase Crop Yields by
Managing Pollinator and
Beneficial Insect Habitat in
the Pacific Northwest**



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Funded by a Western SARE grant

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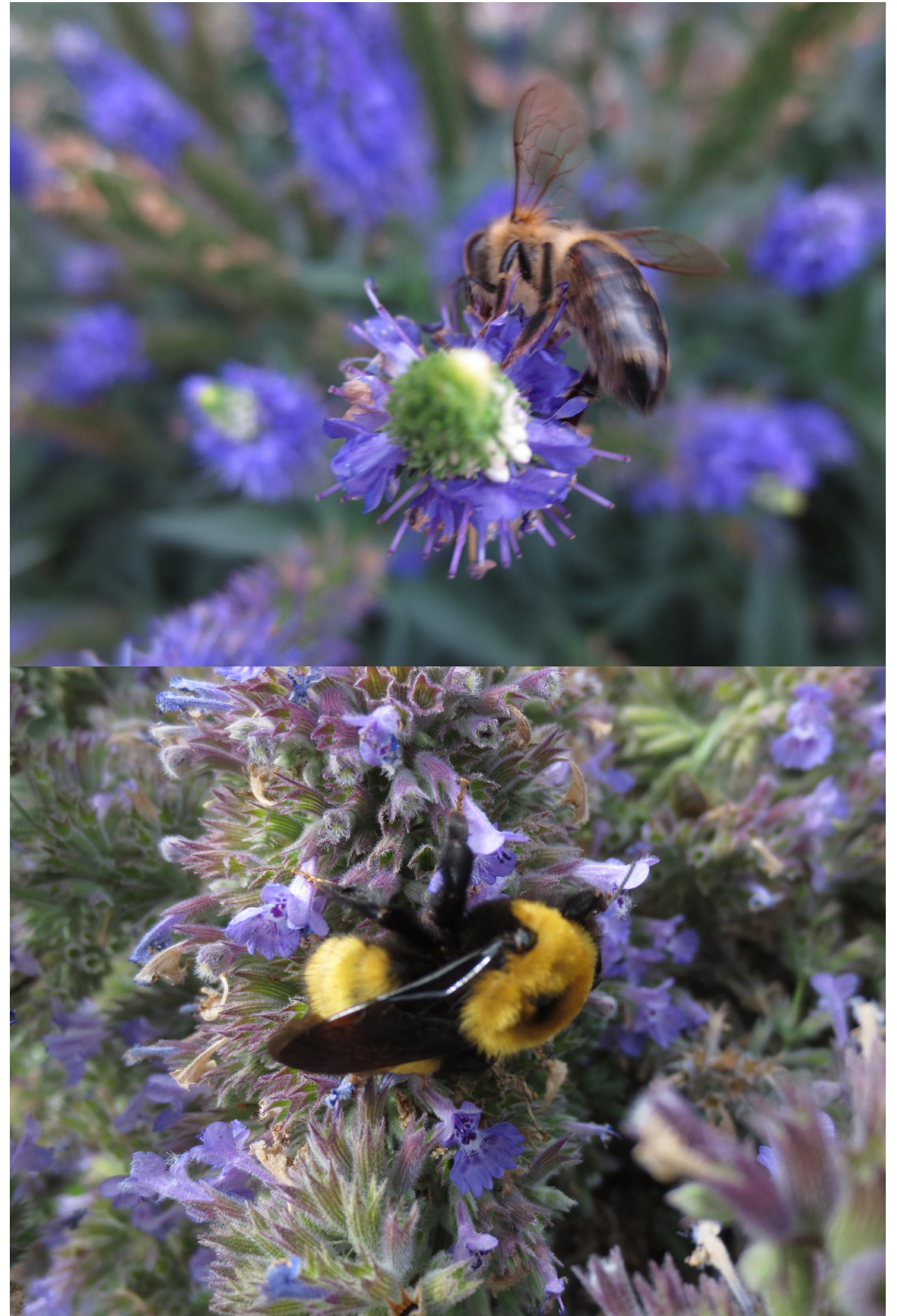
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All photos were taken by Susan or Jane Fluegel
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What is a pollinator?

Pollinators help plants reproduce. Pollinators visit flowers to feed, collect pollen, drink nectar, relax, or just party with their friends. While on the flower, pollinators either actively collect pollen grains from the male anther of the flower or accidentally get pollen grains stuck to their bodies. Many plant blooms are designed so that it is very easy for pollen to come into contact with pollinators.

Pollen can rub off on the female stigma of the first flower visited or it can be transferred when the pollinator visits another flower. Once on the stigma, the pollen germinates and fertilizes the blossom. This results in a seed or fruit developing. You need to have enough pollen transfer to fully fertilize the fruit or seed. Too little pollen results in a smaller or misshaped fruit.



Honeybees get all the press but there are a wonderful variety of pollinators and beneficial insects. Researchers estimate that between 200,000 - 350,000 different animal species help with pollination. These include bees, bats, bird, bats, butterflies and others. According to Reilly et al. 2020, flower visits by wild bees result in higher crop yields than the same number of flower visits from honeybees. This could be because native bees are more adapted to the plants they are pollinating.

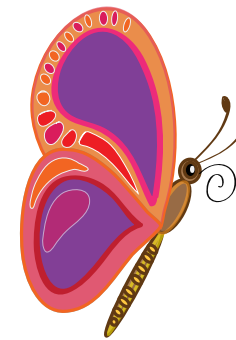
Some plants do not need animal pollinators. They self pollinate or use wind or water pollination. However, approximately 75% of our crop plants need pollinators. Fruits and seeds from pollination are a vital part of the diet of 25% of all birds and many mammals. In addition, 90% of flowering plants require animal pollination for seed production. For these reasons, pollinators are considered an ecological keystone species group.

A keystone species is a plant, animal, insect, bacteria or fungi that keeps an ecosystem together. This organism plays a vital and unique role in the way an ecosystem functions. Without keystone species, the ecosystem might cease to function or look very different. Imagine a world without most flowering plants.

The Pollinator Lineup

Pollinators come in all shapes and sizes!

- Honeybees**
- Bumblebees**
- Solitary bees**
- Other native bees**
- Bee mimics**
- Bee flies**
- Flies**
- Midges**
- Hover flies**
- Wasps**
- Butterflies**
- Moths**
- Beetles**
- Ants**
- Thrips**
- Mosquitoes**
- Bats**
- Birds**
- Lizards**
- Some mammals**



Increasing pollinator number and diversity makes farms more profitable



Pollinators increase profits

Crop yields throughout the USA are limited due to a decline in native pollinators. Reilly et al. 2020 looked at seven crops in 131 different locations and found that the value of wild pollinators is over \$1.5 billion. Wild pollinators contribute greatly to crop yields and quality.

The value of wild bees is extremely significant in some crops. Reilly et al. 2020 mentioned that in apples alone, native pollinators have a value of \$1.06 billion in the USA. The Xerces Society estimates that the value of wild pollinators to 100 USA crops exceeds 3 billion dollars a year!

The value of overall world food crops dependant on pollination is estimated at between \$235 and \$577 billion a year. This includes crops pollinated by honey bees and midges, which pollinate cacao plants. Of course, it is hard to put any value on the benefit of fresh fruit and vegetables. I won't even mention the loss of chocolate to the globe.

Pollinators increase yields

Plant who are fully pollinated grow bigger fruit that is more symmetrical. Over 75% of crops are pollen limited, meaning that their yield is less if they do not receive adequate pollination. Increasing pollinator numbers in these crops will increase plant yield and quality. Blueberries will be bigger and apples more symmetrical with adequate pollination.

There is evidence that plants put more resources and nutrients into adequately pollinated fruit. Pollination stimulates production of auxin and gibberellic acid, two plant hormones. Auxin increases cell division and growth which makes fruits heavier and firmer. Gibberellic acid inhibits fruit softening. This helps prevent bruising and molding. In addition, high concentrations of auxin and gibberellic acid can increase anthocyanin accumulation. Anthocyanins are antioxidants that increase the nutritional value of fruits. These healthy pigments give fruits their dark red, purple, blue or black color.

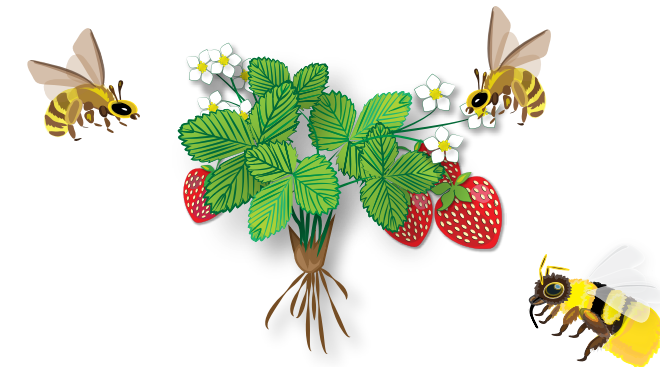


Pollinators increase crop quality

Pollination improves more than yield and fruit set. Klatt et al. 2008 found that strawberries pollinated by bees are redder, brighter, firmer and more symmetrical when compared to self pollinated berries. Bee pollinated strawberries have increased quality, a longer storage life and greater market value. Researchers graded the berries according to a commercial scale. Pollination by bees had a 54% higher market value when compared to self pollinated strawberries and a 39% higher value when compared to wind pollinated strawberries. Pollination treatment had more influence than the plant variety.

In a similar finding, Wietzke et al. 2018 reported that insect pollination increased the commercial value of strawberries by 92%! Strawberries pollinated by insects were better looking, better tasting and stored longer than self-pollinated fruits.

Klatt et al. 2008 estimated that without the increased storage life of bee pollinated berries, USA farmers would lose 11% of their strawberry crop annually. This was worth \$385 million in 2017.



Diversity increases farm yields and profits

Putting in pollinator strips could increased economic viability of farms while increasing native pollinator habitat. Montana growers on four diversified farms established perennial flower strips using nine species of native wildflowers. Delphia et al. 2019 found that the potential revenue from retail flower seed sales exceeded the costs of planting and maintaining wildflower strips after the second growing season. Flower strips also increased numbers of native bees on the farm.

Cusser et al. 2016 found that pollinator abundance and richness counteracts pollen limitation in cotton. Cotton bolls receiving perfect pollination were 18% heavier than those who received adequate pollination. The same study estimated that increasing wild pollinator habitat in the landscape around cotton fields could add \$108/acre profit and a regional gain of over \$1.1 million.

Pollinator habitat enhances sustainable agriculture

Pollinator habitat is a vital part of sustainable agriculture. Farmers and ranchers can play a significant role in enhancing pollinator habitat. Practices that increase pollinators and beneficial insect habitat also benefit growers.

Providing habitat for pollinators and beneficial insects:

- ***Produces a bountiful harvest***
- ***Helps control pest insects***
- ***Enhances soil health***
- ***Strengthens watershed quality***
- ***Improves air quality***
- ***Amplifies wildlife habitat***
- ***Boosts social responsibility***
- ***Reduces food transportation costs and emissions***
- ***Creates beauty***



Produces a bountiful harvest

Low wild pollinator populations limit crop production. Providing pollinator habitat, in the form of a more diverse semi-natural crop landscape, increases native pollinator and beneficial arthropod communities (Aguilera et al. 2020). Increasing pollinator numbers and diversity increases pollination and crop yield. Adequate pollination produces better looking, larger fruits and vegetables that store longer and can be sold for a premium market price. This increases farm profits.

Helps control pest insects

Pollinator habitat can serve a dual purpose as a home for helpful beneficial insects and beetles (Sidhu and Joshi 2016). Many beneficial insects, especially wasps, use pollen and nectar as food while doing a little pollinating on the side. These natural predators control harmful insects by snacking on pest insects and parasitizing pest insects and their larvae (Getanjaly et al. 2015).

Albrecht et al. 2020 found that strips of native and/or non-native flowering herbaceous plants enhanced pest control in adjacent fields by 16% on average. In addition, crop pollination increased with flowering plant species diversity and with increasing age of the plants. In addition, adequate pollination results in a more robust harvest which may result in less need to use pesticides to improve yield

Enhances soil health

Pollinator habitat enhances soil health by reducing the need for pesticides. Beneficial insects living in pollinator habitat keep pests in check which can reduce pesticide applications. Soil is a living ecosystem which is adversely effected by pesticide residues. Adding a cover crop or grasses increases soil health while supporting pollinators.

Improves air quality

Pollinator habitats can function as windbreaks. Windbreaks improve crop production and increase air quality through dust reduction. Air quality is enhanced due to decreased soil erosion by wind.

Strengthens watershed quality

Pollinator habitat strengthens watershed quality since perennial plants stabilize soil to eliminate runoff and combat soil erosion. Adequate pollination results in bigger yields with less inputs. This can reduce or eliminate the need for fertilizer and reduce fertilizer runoff into watersheds. Pollinator habitats can stabilize banks, field edges and transitional zones.

Amplifies wildlife habitat

Wildlife habitat is amplified since pollinator habitat can also serve as shelter and food for wildlife.

Boosts social responsibility

Enhancing pollinator habitat is socially responsible. Pollination research helps keep food affordable for all income groups due to increased production and reduced costs of production.

Reduces food transportation costs and emissions

Adequate pollination of crops increases local food production. This reduces the fuel and the emissions associated with transporting food long distances.

Creates beauty

Thriving pollinator communities are a valuable resource for future generations. Bees inspire art, poetry, science and research into flight and biosensors (Bromenshenk et al. 2015).

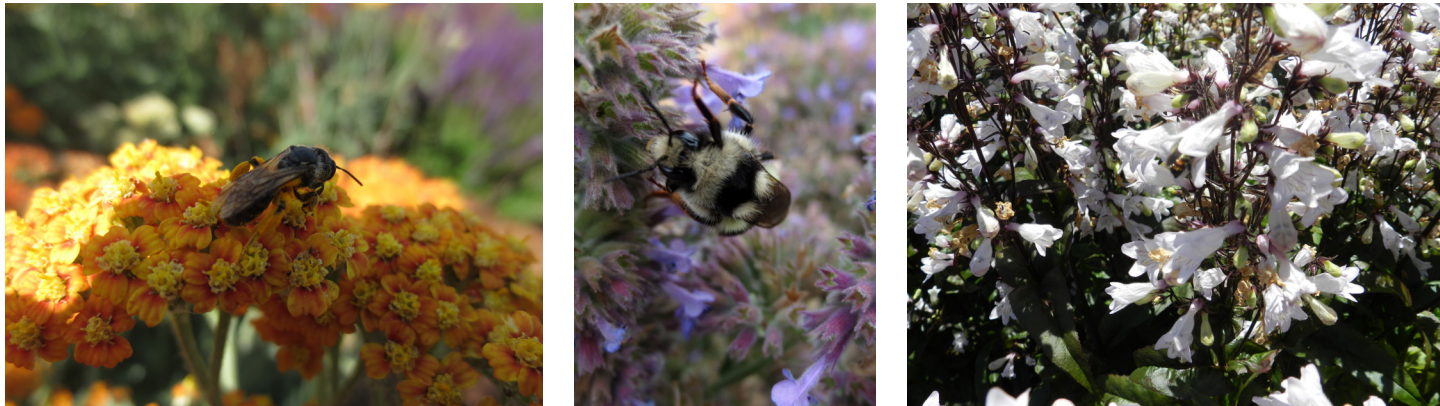
How to create attractive, non-weedy, economical pollinator habitat

Select Your Plants Carefully

1) Research your plants carefully. Do you want fussy perennials that you have to baby or do you want tough flowering warriors? Carefully choosing plants suitable to your climate and soil type gives you a huge advantage over randomly selecting some blooming plants at the local garden center. Many of the plants available at chain garden centers are selected for their popularity not for their hardiness. In addition, it helps to have plants that will muscle out the weeds without taking over your yard or farm.

2) Choose flowers that provide pollen and nectar for pollinators. Over-bred hybrids, wacky looking blooms, or oddly colored designer flowers may not provide the food pollinators need. Amazingly, some flowering plants are bred to be sterile and no longer produce pollen or nectar.

Fancy flower configurations can hinder pollinators as well. For example, double blooms often prevent pollinators from accessing the pollen or nectar, and are almost always sterile. Other modern plant cultivars may have reduced nutritional benefits. Just because it is a feast for the eyes doesn't mean it is a feast for the bees.



3) Watch out for designer plants that are bred to have dark or unusual colored foliage. Exotic leaf colors may be toxic to insects. Cultivars of ninebark (*Physocarpus species*) are bred to have deep gold or red leaves are distasteful to feeding caterpillars. These dark leaves contain more anthocyanins, a pigment which may be toxic in larger amounts to herbivore insects (Wilde et al 2015). Native plants with naturally dark foliage are alright to use.

4) Pick a variety of plants that grow well together. Perennial flower habitat with a higher flowering plant diversity enhanced pollination compared to less diverse habitat (Albrecht et al. 2020).

5) Select keystone species that attract a variety of pollinators. Perennials plants are good choices since they will bloom for years. Shrubs and flowering trees can be excellent low care pollinator and wildlife habitat as well.

6) Choose plants that bloom throughout the season, like catmint and salvia, or plants that have overlapping blooming times. For maximum pollinator density make sure you have food available to the pollinators from early spring to late fall.

If you have crops that need pollination select pollinator friendly crops that help fill in gaps left by blooming crops. For example, if you grow June bearing strawberries you will want pollinator plants that bloom before and after June. Two time blooming periods that are vital for pollinator survival are early spring and late fall.



7) Be careful where you buy your perennials. Plants at many garden centers are sprayed with systemic insecticides! These insecticides can stay on the plant for a long time. Obviously, these would be a poor choice for a pollinator habitat. If you buy treated plants, instead of welcoming pollinators into your garden, you may be inadvertently killing them!

Nitroguanidine pesticides; which include clothianidin, dinotefuran, imidacloprid, and thiamethoxam; are some of the most commonly used insecticides in garden centers and plant nurseries (Simon-Delso et al. 2014). These pesticides can remain in the soil for over a year and a half. Nitroguanidine treated plants can produce toxic pollen, nectar, and guttation droplets for more than two seasons.

Guttation is a fluid produced by xylem and phloem sap. It is secreted at the margins of leaves from many plant species and is a valuable source of food for bees, wasps, flies and other insects (Urbaneja-Bernat et al. 2020).

Planting a perfect pollinator plot

- 1) Select a good location for your pollinator plants. Most pollinator plants need at least partial sun.
- 2) Plant your botanical beauties in blocks or masses to attract and feed more pollinators.
- 3) Put somewhat aggressive plants, such as catmint, away from more delicate plants.
- 4) Prepare the soil well. Sometimes it is easier to start with a clean slate. If the ground you want to use is very weedy get rid of the weeds before planting your perennials. One easy way to do this is by solarizing. Lay down a large sheet of plastic over the pollinator planting plot. Make sure to hold down the edges of the plastic so it doesn't blow away. Leave in place long enough to kill the weeds underneath.
- 7) Ideally plant in fall or spring depending on your climate. Midsummer is the worse time to plant. If you have to plant midsummer, you will need more water and you may need to provide temporary shade over your transplants.
- 8) Mulch around plants to prevent weeds and preserve moisture.
- 9) Water for at least the first year to help plants establish. Some everblooming plants, such as salvia and catmint, will bloom all season if given midsummer water. Pictured below are catmint, gaillardia and shasta.



Pollinator modules for planting

For maximum benefits plant flowers that are compatible with your climate, soil and plant growing experience. If you want to stretch your growing skills consider making 90% of your varieties easy care plants and selecting one or two challenging plants to try out. I recommend a compatible mix of plants that blooms all summer.

Easy Care Pollinator Module

Maximal beauty and minimal care

- Plant a mix of catmint 'Walker Low' and salvia 'Caradonna'
- This beautiful blue mix will bloom from spring into fall.
- To add a little punch to the middle of the summer where both plants send up new growth, add liatris, yarrow and/or gaillardia
- To augment fall flowers, plant asters or helenium

Forgotten Pollinator Modules

Give a little love to the flies and the wasps that help pollinate

- Over 10% of pollinator visitors during midsummer were pollinating flies in yarrow, penstemon 'Red Husker', campanula 'Superba' and Shasta Daisy 'Alaska'
- Veronica 'Allord' and yarrow attracts 12-25% solitary wasps in late summer
- Aster is everyone's favorite plant for the fall
- Add catmint or salvia for early spring blooming

Honey Pot Plant Modules

Each of these plants attracted 15-45% honeybees when in bloom

- Catmint 'Walker Low' attracts both honeybees and bumblebees
- Campanula 'Superba' is a good early summer bloomer
- Yarrow 'Red Velvet' and 'Terra Cotta'
- Salvia 'East Friesland'
- Veronica 'Allord'
- Helenium for fall pollinator food



Native Bee Bounty

Maximize native bees with this combination

- Over 40% of pollinator visitors were Halictidae (native sweat bees) in Salvia 'Caradonna', shasta 'Alaska', gaillardia, echinacea, and helenium
- Shasta, salvia and gaillardia are visited by over 10% Megachilidae (native solitary and mason bees)
- Catmint, salvia 'East Friesland', campanula, veronica, echinacea, and liatris brought in over 1/3 bumblebees

Proven Pollinator plants for the Northwest

A selection of tested pollinator plants for our area.

All these plants survived summer days where the temperatures dropped into the freezing zone (very low 30°F) at night and soared into the 90°F the next day (a 50°F temperature change). Plants continued blooming into the fall with nighttime temperatures dipping down to the upper 20's°F. They even shook off fairly heavy frost covers with minimal damage.

These plants are tough! With some basic care for the first or two year after planting they will bloom and attract pollinators for years.

Super tough low-care plants

- Salvia Caradonna
- Nepata x faassenii 'Walker's Low' catmint
- Achillea millefolium 'Red Velvet'
- Achillea millefolium 'Terra Cotta'
- Campanula glomerate 'Superba'
- Penstemon digitalis 'Husker's Red'
- Salvia nemorosa 'East Friesland'
- Veronica longifolia 'Allord'



Tough low care plants that will reseed prolifically

- Leucanthemum x superbum 'Alaska'
- Liatris spicata 'Floristan Violet'
- Liatris spicata 'Floristan White'

Tough but pickier plants: if they like their location they do well

- Gaillardia 'Burgundy'
- Echinacea 'Hot Summer'
- Helenium autumnale MARIACHI 'Bandera'

This pollinator study was funded by a WSARE Farmer grant.

Plants on next page

Top: Helenium autumnale MARIACHI 'Bandera' planted with Nepata x faassenii 'Walker's Low' catmint

Bottom: Liatris spicata 'Floristan Violet' and 'Floristan White' colors mixed.



Nepata x faassenii ‘Walker’s Low’ catmint **Catmint brings on the bees**

Catmint is a hardy plant that will survive whatever you put it through while looking attractive for most of the growing season. It will happily crowd out weeds and weaker plants so be careful where you place it. After you get it established, it is very hard to kill. It is, however, easy to dig up and transplant. Bumblebees and honeybees love this plant!

Plant Care

- Zone 3-8 (laughs at light frosts)
- Extremely easy care
- Deer proof
- Requires little water once established
- Likes sun or partial sun
- Grows into a 2 by 3 ft. gorgeous blue mound covered with light blue bloom sprays
- Slight amount of reseeding but not excessive
- Dead growth can be mowed or cut back in early spring
- Tough plant with no winter kill observed



Pollinator superpowers

- Catmint brings all the honeybees to the farm
- In plots containing at least half catmint, around 1/3 of the pollinator visits were from native bumblebees
- One of the first perennials to bloom in spring
- Re-blooms on new growth into fall
- Will bloom almost continually from early May to the first hard killing frost in October or November if they are given a little midsummer supplemental water to stimulate new growth
- Will outgrow and smother most weeds after the first year or two
- Perfect for farms and low care gardens

Salvia nemorosa Caradonna **Classic beauty**

Gorgeous dark blue purple flowers from spring to fall. Attracts many pollinators as well as humans visitors; many people told us this was their favorite plant. This plant is elegant and classy looking. Salvia looks like it requires a lot more care than it actually does. Mix with catmint for a beautiful blue mosaic power duo.

Plant Care

- Zone 3-8 (resistant to light frosts)
- Easy care
- Deer proof
- Requires very little water once established
- Likes sun or partial sun
- Extremely controlled and neat growth habit
- Mature plants out compete weeds
- Beautiful plant with outstanding color
- Little to no reseeding
- Dead growth can be mowed or cut back in early spring



Pollinator superpowers

- Attracts a good mix of native pollinators
- In Caradonna salvia plots approximately 45% of pollinator visits were from the halictidae family (native sweat and metallic bees)
- One of the first perennials to bloom in spring
- Re-blooms on new growth into fall
- Our plants bloom almost continually from May to the first hard killing frost in October or November if they are given a little supplemental water in the middle of the summer
- Tough enough for the farm and elegant enough for a formal garden
- Will attract both pollinators and compliments
- People asked for cuttings from this plant

Penstemon digitalis ‘Husker Red’ Gorgeous natar

This exotic looking native Pacific Northwest plant has standout dark red foliage. It is gorgeous when in bloom and attracts a lot of attention from bees and people alike. This plant is attractive at all part of its bloom cycle. Buds, blooms and the resulting dark red seed heads are all extremely striking. Seed heads look great in decorative floral arrangements.

Plant Care

- Zone 3-8 (resistant to light frost)
- Easy care
- Deer resistant
- Requires little water once established
- Likes sun or partial sun
- Likes well drained soil
- Beautiful mature plant has red foliage with white blossoms and dark red seed heads
- Little reseeding
- Dead growth can be mowed or cut back in early spring



Pollinator superpowers

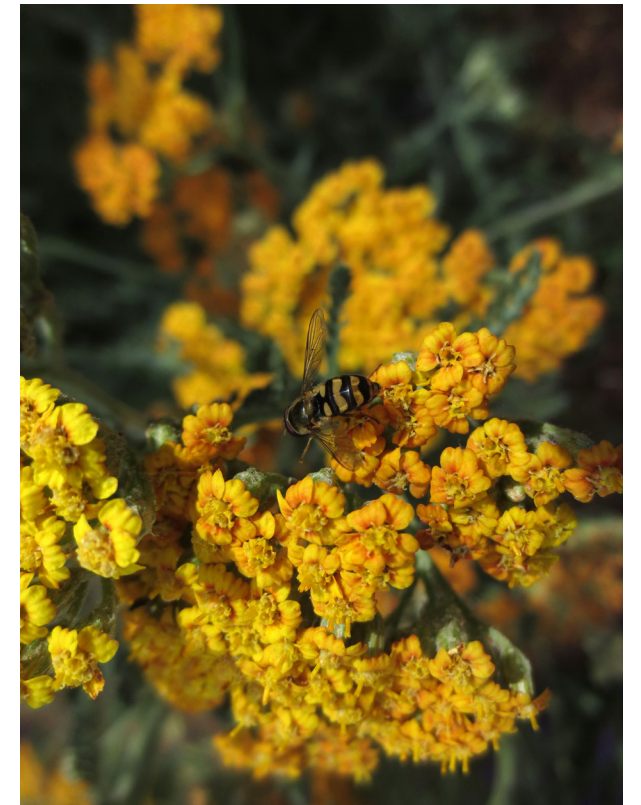
- Striking appearance attracts spring pollinators
- Blooms in mid-spring with white pink flowers against red foliage
- Seed heads are dark red, glossy and very decorative
- In penstemon plots approximately 45% of pollinator visits were from the Megachilidae family (native solitary bees such as mason and leafcutter bees)
- It also attracted a high percentage of bumblebees and native halictid bees (sweat and metallic bees)
- This is a gorgeous plant that is very well adapted to this climate and much loved by native pollinators

Achillea millefolium ‘Red Velvet’ and ‘Terra Cotta’ Stately natar

Yarrow is a striking plant and dominates a setting. This plant is very showy in the garden or farm and looks great in a group of 3 to 7 plants. It will overshadow smaller plants. Red Velvet is a shorter more controlled plant with dark red blooms around 3 feet tall. Terra Cotta grows up to four feet with a gorgeous multicolored yellow to orange bloom.

Plant Care

- Zone 3-8 (resistant to light frosts)
- Easy care
- Deer proof
- Requires very little water once established
- Likes sun or partial sun
- Tall stately plant that may need support
- A small amount of reseeding with Terra Cotta
- Dead growth can be mowed at 4-6 inches or cut back in early spring which make maintenance fast and easy



Pollinator superpowers

- Attracts many small pollinators: especially beneficial wasps, flies and bee mimics
- This plant attracted the greatest diversity of pollinators
- Blooms for months in mid-summer
- In Terra Cotta yarrow plots approximately 25% of pollinator visits in summer were from the Diptera family (native pollinating flies); this increased to over 45% Diptera in Red Velvet yarrow
- Flies are often neglected since they are not as charismatic as bees; however, they pollinate over 100 cultivated crops (Ssymank et al. 2008)
- Great attention getter that towers over other flowers
- Shades out weeds

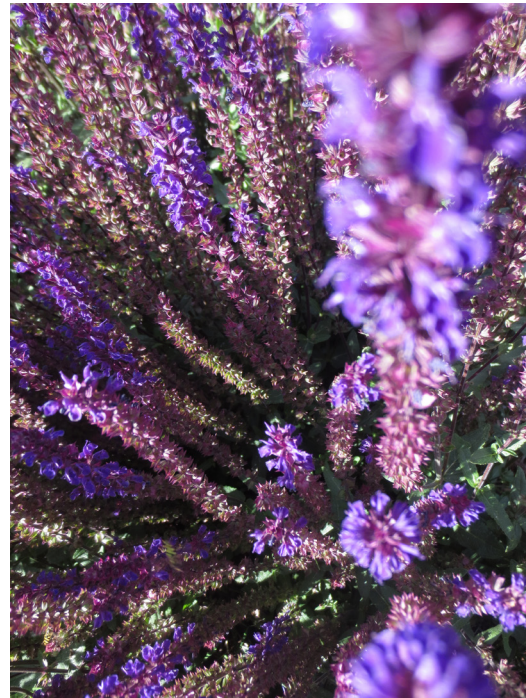
Salvia nemorosa ‘East Friesland’

Hard working beauty

Gorgeous light blue purple flowers. A little messier than its salvia cousin, Caradonna, but still fairly neat. Attracts a high percentage of bumblebees. Grows fast and blooms almost all season. This is a nice plant that attracts many pollinators. It is a very attractive plant that complements other pollinator plants well.

Plant Care

- Zone 3-8 (ignores light frosts)
- Easy care
- Deer proof
- Requires little water once established
- Likes sun or partial sun
- Our plants bloom almost continually from May to the first hard killing frost in October or November if they are given a little supplemental water in the middle of the summer
- Little to no reseeding
- Dead growth can be mowed or cut back in early spring



Pollinator superpowers

- Attracts many pollinators: especially bumblebees and honeybees
- In ‘East Friesland’ salvia plots approximately 45% of pollinator visits were from Bombus species (native bumblebees)
- Honeybees also like this plant
- Blooms starting in mid-spring and continue most of the growing season
- Re-blooms on new growth into fall if given water in mid-summer
- Lovely light purple blue blooms are usually crawling with happy pollinators
- Extremely low care plant grows into an attractive shape
- Holds its own with most weeds

Veronica longifolia ‘Allord’

Pollinator magnet

Attractive tidy plant with shiny dark green leaves and dark purple candle-like flower stalks. This plant attracts more than its fair share of medium and small pollinators. When it is in full bloom it is totally covered with crawling pollinating insects. It may hold the record for most pollinators per square inch.

Plant Care

- Zone 3-8 (resistant to light frosts)
- Easy care
- Deer proof
- Requires little water once established
- Likes sun or partial sun
- Extremely controlled growth habit makes this a very neat plant
- Plant growth forms discrete rounded columns
- No reseeding observed
- Dead growth can be mowed or cut back in early spring



Pollinator superpowers

- Attracts many varieties of pollinators especially beneficial wasps, adorable small fuzzy bumblebees, and small ground nesting bees
- Six veronica plants attracted approximately 2200 pollinators per hour in late summer
- In Veronica plots approximately 1/4 of pollinators seen in early summer were from the Andrenidae family (native solitary ground nesting and mining bees)
- Later in the summer, about 1/4 of pollinator visits were from the Apocrite family, mostly small pollinating solitary wasps
- Blooms mid to late summer
- Extremely attractive and photogenic
- Dark glossy green foliage with very tidy growth habit
- Suitable for even formal gardens

Campanula glomerate 'Superba'

Bumblebee magnet

Extremely deep blue bell like flower clusters adorn an interesting looking plant. If you want to see bumblebees this is the plant for you. The cute little buzzers crawl right into the bell-shaped blooms to pollinate. This plant is a nice early blooming plant with deep blue bell like flowers.

Plant Care

- Zone 3-8 (resistant to light frosts)
- Fairly easy care
- Deer proof
- Requires little water once established
- Likes sun or partial sun
- Interesting looking plant with extremely blue bell like blooms
- Reseeds a little but not excessively
- Dead growth can be mowed or cut back in early spring
- Can be a little messy looking
- Spreads slowly from base but is not aggressive



Pollinator superpowers

- A favorite of small to medium bumblebees and solitary bees
- In campanula plots approximately 1/3 of the pollinators were native bumblebees and 1/3 were from the Halictidae family (native sweatbees)
- Great plant for people who think that bumblebees sticking out of flowers are adorable
- Usually prompts conversation since it is a very unusual plant with eye catching blooms
- Flowers in early summer
- Plant tends to die down midsummer and send up new shoots

Leucanthemum x superbum 'Alaska'

Friend of diverse pollinators

Pretty daisy looking plant has a unique somewhat odorous smell that bothers some people more than others. Has invited several arguments in the field about whether or not it is stinky or smells like dog poop (spoiler, some say yes and others disagree). The smell does attract many smaller pollinators especially tiny wasps, bees and flies. Will happily reseed large areas if spring weather is the slightest bit wet.

Plant Care

- Zone 3-8 (fairly resistant to light frosts)
- Easy care
- Deer proof
- Requires very little water once established
- Likes sun or partial sun
- Short lived perennial
- Will reseed prolifically and keep repopulating an area
- Dead growth can be mowed or cut back in early spring
- Bumblebees are not as attracted to it
- May not want to plant right under an open window
- Can look a bit messy as it matures; fine for farm, bad for formal gardens unless groomed



Pollinator superpowers

- May have had the most interesting combination of insect pollinators swarming to it
- Strong smell attracts many pollinating flies and bee mimics
- In shasta plots, approximately 50% of visiting pollinators were from the Halictidae family (sweatbees), 12% of were flies and 6% were pollinating wasps
- Blooms for a long time in summer
- Has caused cars to stop and back up to photograph it when it blooms in mass
- White blooms compliment the bloom colors of other pollinating plants
- Will totally cover an area in a short time

Liatris spicata ‘Floristan Violet’ and ‘Floristan White’ Gorgeously abstract

These natives (a cultivar derived from a native plant) really grew on us. They are truly spectacular when mature and flowering. The interesting structural arrangement of their stems and leaves makes a very unique statement in the garden. People always ask about them. Choose this plant if you want a statement piece in your yard.

Flower spikes are a true white and a wonderful violet! Grow if you like a statement plant that people will ask you about. Beloved by bumblebees and native pollinators alike.

Plant Care

- Zone 3-8 (light frosts have no effect)
- Looks delicate but is actually extremely easy care
- Deer proof
- Requires very little water once established
- Likes sun or partial sun
- Likes well drained soil
- Fun and unusual growth habit; looks almost fake at times
- Extremely striking plant as it matures, especially when blooming
- Reseeds moderately
- Dead growth can be mowed or cut back in early spring
- Will take a little while to emerge in the spring



Pollinator superpowers

- In liatris plots approximately 40-50% of the pollinators were native bumblebees
- Bumblebees and Halictidae will cover the flower spikes when it blooms
- Blooms mid to late summer
- Ideal for a statement plant
- Fascinating stem and leaf texture makes it interesting even when not blooming
- Has a bulb even as a seedling

Aster ‘Purple Dome’ Purple flowers for fall

These were the last plants left blooming after a major killing frost in October. The mound like asters bloomed until November. They were covered in rich purple flowers and swarms of metallic green sweat bees (Halictidae family) and medium sized bumblebees. These extremely photogenic plants provided late autumn food for pollinators.

Plant Care

- Zone 3-8 (extremely resistant to even medium frosts)
- Fairly easy care
- Deer proof
- Requires little water once established
- Likes sun or partial sun
- Neat nondescript plant forms green mounds until suddenly covered in rich purple flowers in fall
- No reseeding noticed
- Dead growth can be mowed or cut back in early spring
- Great colorful purple mounds for fall color and pollinator food



Pollinator superpowers

- A favorite of solitary bees, small bumble bees, sweat bees and leaf cutting bees
- Great plant for people who like iridescent sweat bees and cute medium sized native bees
- Blooms in fall even after medium frosts that wilted all the other plants
- Dripping in medium sized and small pollinators in fall
- One of the last sources of food for pollinators before winter in this area
- It is important to include late fall blooming plants in your pollinator plots to allow pollinators to gather food for winter

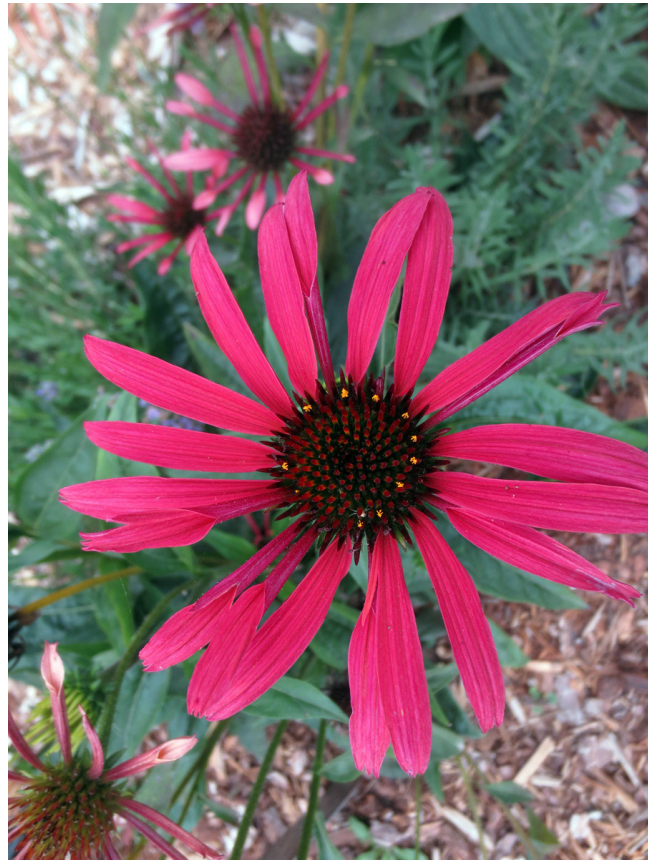
Echinacea 'Hot Summer' **Exotic but picky**

Gorgeous plant with unique iridescent flowers gets tons of compliments. Almost looks fake when in full bloom. Grows great if they like where they are planted. Dies overwinter if they don't approve of your planting spot. The catch; you don't know if they will like the spot or not until you try it!

Beautiful blooms for those who don't mind a bit of a gamble or are up for a challenge. Attracts bumblebees and looks good paired with lavender.

Plant Care

- Zone 4-8
- Deer proof
- Picky about placement in garden but not necessarily about care
- Requires little to moderate water once established
- Needs well drained area; will root rot and sulk in soggy areas
- Does not like its base covered at all; be careful with mulch depth - use only a couple of inches
- Likes sun or partial sun
- No reseeding observed
- Dead growth can be mowed or cut back in early spring



Pollinator superpowers

- Attracts medium pollinators, especially extremely cute bumblebees
- Blooms stand out in the field
- Great plant for a pollinator photo shoot
- Blooms in midsummer
- Extremely eye catching bloom colors are almost fake looking
- Looking pretty so people want to plant it even if it is fussy and picky

Helenium autumnale MARIACHI 'Bandera' **Beautiful late bloomer**

Extremely colorful autumn blooming plant that grows in a tidy mound. Blooms are yellow, red and orange and attract masses of small bees and other insects. This plant may tie with 'Allord' Veronica for most pollinators on blooms. If you love green metallic sweat bees this and asters are the plants for you.

Great blooms for a blanket of fall color. Needs hot late summer weather to develop into full bloom.

Plant Care

- Zone 4-8 (resistant to light frosts)
- Fairly easy care
- Deer proof
- Requires little water once established
- Likes mostly full sun, tolerates partial sun
- Totally covered with masses of yellow, red and orange blooms in fall
- Did not observe reseeding
- Dead growth can be mowed or cut back in early spring
- Unobtrusive neat green foliage grows in a neat mound until it erupts into bloom
- A very tidy plant



Pollinator superpowers

- A favorite of small to medium bumblebees and solitary bees
- In helenium and catmint mixed plots approximately 40-50% of the pollinators were native Halictidae; native bees that nest in the ground
- Provides food in autumn when other flower sources are spent
- Hot colored yellow, orange and red variable blooms provide a beautiful contrast with purple or blue flowers of other plants
- Blooms late summer to autumn after other flowers are done blooming

Common Pollinators

Check out these pollinator photos to identify that helpful insect on your plants

Is it a bumblebee (family Apidae)?

- Do you want to pet it?
- Fuzzy, stout and makes buzzing noise
- Slow flight
- Typical colors: black, yellow, orange, red, white
- Most have bands or spots
- Normally non aggressive and peaceful



Is it a sweat bee (family Halictidae)?

- Some in this family are metallic
- Many small metallic dark bees as well
- Often the most numerous native bees on flowers
- Extremely diverse
- Can be solitary, communal or social
- Many are ground nesting



Is it a leaf cutter bee (family Megachilidae)?

- Carries pollen on it's abdomen on special hairs called scopa
- Includes leaf cutter and mason bees
- Mostly solitary bees
- All species feed on nectar and pollen
- Some cuckoo bees steal pollen collected by other bees



Common Pollinators

Is it a butterfly (super-family Hedyllidae)?

- Looks like a flying flower
- May be pests in larva stage
- Make use of camouflage, mimicry and aposematism (bright colors to advertise toxicity) to evade their predators
- Fluttery flight



Is it a hawk moth (family Sphingidae)?

- Long antenna
- Bold wing patterns
- Long proboscis to feed on nectar rich flowers
- Zips from flower to flower quickly and can be mistaken for hummingbird
- Can learn colors (Kelber 1996)



Is it a honeybee (family Apidae)?

- Smooth striped fairly chill bee
- Worth billions in pollination services
- Social bee
- Hives have a main queen
- Likes to make honey when not pollinating
- Collects pollen and nectar



Common Pollinators

Is it a fly (family Diptera)?

- Plays an important and under appreciated role in pollination (Oxford et al. 2015)
- Common and diverse
- Carries pollen on body bristles
- Second only to the Hymenoptera in pollen carrying ability
- Needs more love



Is it a solitary wasp (family Sphecidae)?

- Are solitary insects without a hive
- Do not sting for fun; no hive to defend
- Use stinger to immobilize prey to feed their young
- Adults feed on nectar
- Often thread waisted
- Pictured insect is a digger wasp



Is it a ladybug (family Coccinellidae)?

- Adorable beetle has great PR agent
- Both adults and larvae consume aphids, scales and other pest insects
- Often covered with spots
- So well known that other spotted beetles are often misidentified as ladybugs



Common Pollinators

Is it a hoverfly (Diptera family Syrphidae)?

- Does it look like a large eyed animal version of a honeybee?
- This is actually a fly
- It hovers above flowers
- Adults feed on nectar and pollen
- Larvae of some species eat aphids and are important natural enemies



Is it a cat (family Felidae)?

- Not a very effective pollinator but great at exploiting people using purring
- Ruthless carnivore
- Commonly found hiding under pollinator plants
- Tries to trip unsuspecting humans walking by plants
- Role in ecosystem can be disruptive



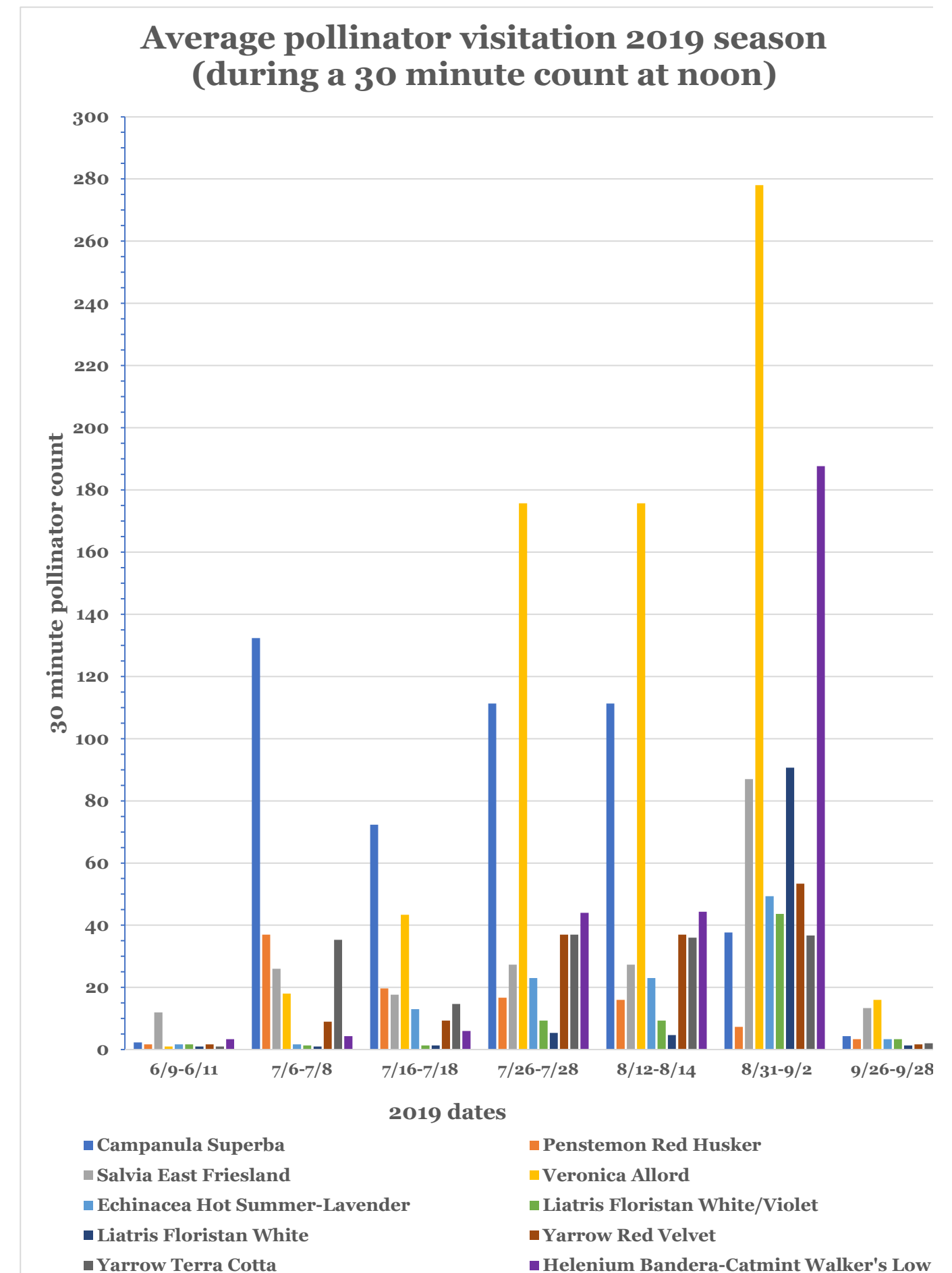
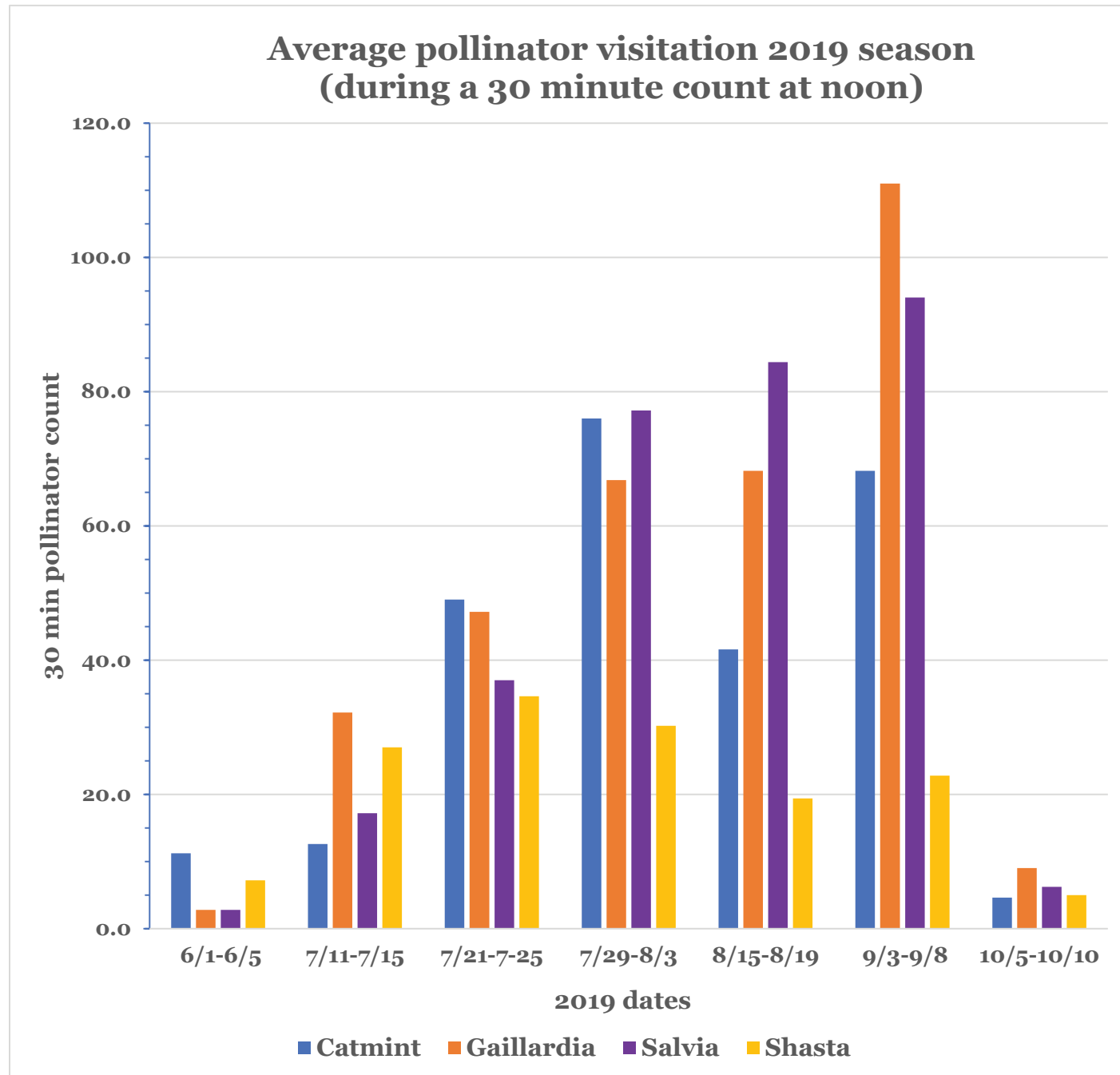
Is it a bee fly (family Bombyliidae)?

- These fuzzy insects are actually flies
- Adults feed on nectar and pollen
- Larval stages are parasites or predators of other insects
- Straight proboscis
- This large fly family is not well known and needs more study



Pollinator visitations to plants over the 2019 growing season

Time-lapse cameras mounted above plants recorded pollinator activity and visitation each day. Pollinators and beneficial insects were counted in 1/4 of each plot for 30 minutes from noon to 12:30 p.m. (the area covered approximately 1.5 pollinator plants). Results from plot repetitions were averaged.



Notes on the WSARE pollinator study

When you are looking at pollinator visitation counts in most insect experiments, you are only seeing the very small portion of the day that was counted. I want you to consider how many pollinators an extremely charismatic plant can bring in.

In the pollinator visitation charts on pages 30-31, it shows the number of pollinator visits in one-fourth of the plot over a 30 minute time period. If you want an idea of how many pollinators a block of six plants can attract per hour, multiple my count by eight! That means a plot of six mature veronica plants was attracting approximately 2,200 pollinators per hour midday in late summer. Moreover, the veronica plants were attracting pollinators all day long.

The noon to 12:30 p.m. time period was selected for pollinator counts since it tends to be warmest in the early spring and late fall. However, noon is not usually the busiest pollinator time in the middle of summer (temperature and pollinators tends to peak at 3-5 PM in the middle summer months). Due to this, peak pollinator numbers in the summer were even higher than shown here.

If you start considering the sheer number of pollinators visiting these plants you can see how many native pollinators you can support with a few patches or strips of plants.

WSARE experiment condensed version

- Time lapse cameras were mounted above plots. You can see cameras on mounts at right. Mounts were adjustable since plants grew rapidly over the season.
- Cameras ran from dawn to dusk
- Plants were monitored from early spring to late fall
- Videos from the cameras were downloaded and watched over the winter
- Pollinators were counted and identified for each group of plant
- Some of the information is reported here: for a full report check out WSARE website at <https://western.sare.org/>



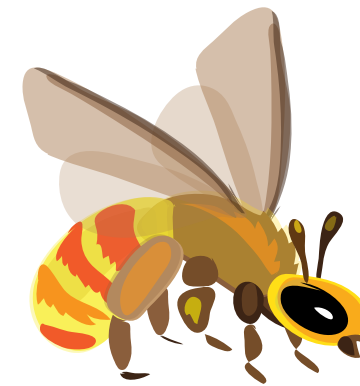
Plant Flowers and Herbs for Market

Dual purpose plants, such as cut flowers and herbs, can serve as pollinator habitat and profitable crops. You can easily mix vigorously growing herbs with perennial and annual flowers to get a beautiful and tasty pollinator patch. Just be careful when harvesting herbs for market to avoid mixing in other non edible plants. Most herbs are hardy and don't require extra care.

Fresh herbs are extremely popular at Farmer's Markets and at local restaurants. Chefs often want to purchase fresh herbs by the pound. Contacting chefs before planting will help you determine what herbs are in demand in your area.

Pollinator friendly herbs include:

Mint
Sage
Hyssop
Marjoram
Thyme
Basil
Fennel
Lemon balm
Borage
Chives
Rosemary
Dill
Cilantro
Lavender
Calendula
Catnip



Herbs, with their interesting and fragrant foliage, can add a touch of sophistication to flower bouquets. Many herbs have gorgeous silvery leaves and stems that complement and enhance flower colors. Herbs were once commonly used in flower arrangements.

Herbal bouquets can also be made for pure culinary purposes. A bundle of herbs whose flavors resonates with each other can be a perfect gift for a foodie. Marketing herbs this way will intrigue people who want to experiment with new flavor combinations.

Pollinator friendly cut flowers

Cut flowers can be very profitable in the right market. Flowers can be sold at farmer's markets, restaurants, weddings/events and florists.

Many plants that attract pollinators can be great additions to floral arrangements. People are attracted to unique and local flowers. You can even include aromatic and/or flowering herbs in floral displays both for additional smell and color.

Some of my favorites flowers from my research are:

- Liatrix spicata (blazing stars) - unique look and long lasting bloom*
- Yarrow - long lasting and very colorful, decorative foliage*
- Gaillardia (blanket flower) - wonderful source of red, yellow and orange blooms*
- Salvia (sage) - beautiful blue and purple bloom stalks*
- Catmint - lovely foliage contrasts nicely with very blue blooms*
- Veronica - great bloom spikes add an intense color*
- Lavender - unique flower with wonderful aroma*
- Asters - wonderful color for fall bouquets*
- Helenium - cheery colorful fall blooms*
- Penstemon - fun tubular flowers, striking foliage and very decorative seed heads*
- Campanula - pretty blue bell blooms*

Unless your Shasta daisies smell a lot better than mine I would not recommend this flower for indoor bouquets. It is still a great for pollinators.

Other good local choices for pollination and cut flowers are:

- Tulips*
- Daffodils*
- Sunflowers*
- Goldenrod*
- Monarda (bee balm)*
- Sea holly*
- Lupines*

This is just a partial list of plants that attract pollinators. Be warned, some lists I looked at included invasive plants and/or plants that do not attract many pollinators. Sometimes only certain plants in a group are good at attracting and feeding pollinators and others are sterile. Sadly, you cannot always rely on garden center employees to let you know which plants are suitable for pollinators in your area. It is better to do your own research and ask other experienced gardeners.

Conclusion

It takes no more time to plant and cultivate a plant that attracts thousands of pollinator than it does to plant and cultivate a plant that attracts zero pollinators. With a little care and selection you can have a flowering strip or plot that attracts attention from both humans and bees!



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