

Conserving Missouri's Wild and Managed Pollinators

IMPORTANCE OF POLLINATORS AND THREATS TO THEM



Objectives

1. Understand what a keystone species is and how this applies to pollinators.
2. Describe two threats to pollinators.
3. Name one type of bumble bee that is threatened.
4. Recognize how feral bees have adapted to *Varroa* mites.



A pack of wolves hunting a moose on Isle Royale, 1966



History- across the millenia

- Insect pollinated crops have been in our diet
- Ancient recognition
 - Egyptian hieroglyphics
 - Greek mythology
 - Native American cave paintings
 - English poetry
- Recently recognized that pollinators are in decline



What do you see in this picture?

Pollinators in Missouri and elsewhere

Importance

- As a keystone species
- For farmland

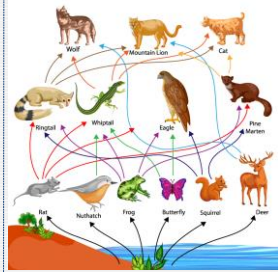


Who's concerned

- Scientists
- Farmers
- Conservationists
- Consumers??
 - One in every three bites of food.....

The Darwin story

- Predominance of certain flowers depended on cats
- Mice raided bumblebee nests, which cats killed
- Flowers dependent on bumblebees increased with more cats
- What do we say about cats on the loose now?



Insect Pollinators: An Ecological Keystone



Wildlife Food Web

- Fruits and seeds are a major part of the diet of about 25% of birds, and many mammals.
- Pollinators are food for wildlife.



6 questions to stimulate your curiosity

Honeybee decline is clearly understood

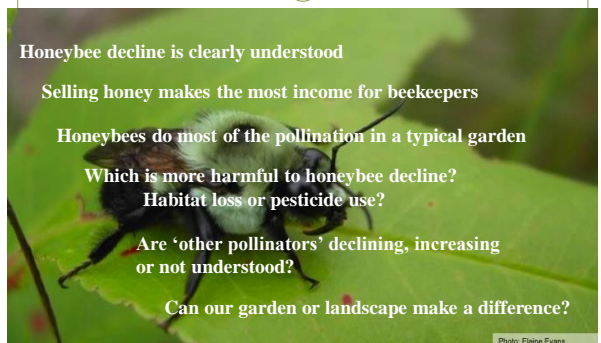
Selling honey makes the most income for beekeepers

Honeybees do most of the pollination in a typical garden

Which is more harmful to honeybee decline?
Habitat loss or pesticide use?

Are 'other pollinators' declining, increasing
or not understood?

Can our garden or landscape make a difference?



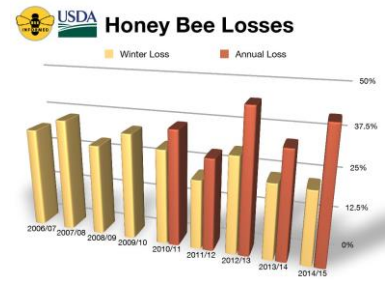
Honey Bees: Non-Native Pollinators

- Most crop pollination is done by the European honey bee.
- Many crops are reliant on this single pollinator, one that is experiencing many problems.



Commercial and hobbyists have suffered

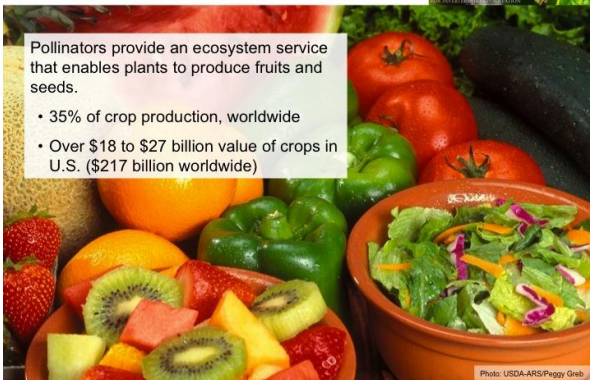
Number of hives has decreased by 60% since the 1990s. Honeybees are still the most economically important commercial pollinator.



The Food We Eat

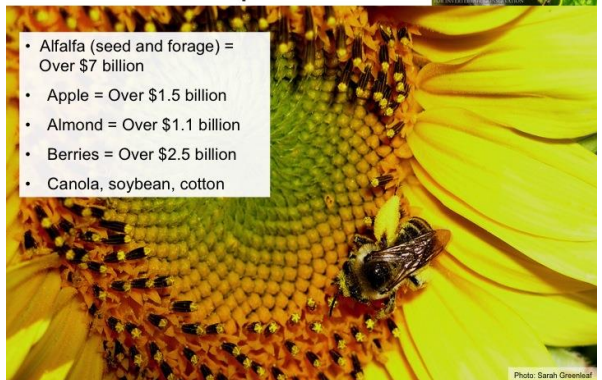
Pollinators provide an ecosystem service that enables plants to produce fruits and seeds.

- 35% of crop production, worldwide
- Over \$18 to \$27 billion value of crops in U.S. (\$217 billion worldwide)



Annual Value of Insect Pollinated Crops

- Alfalfa (seed and forage) = Over \$7 billion
- Apple = Over \$1.5 billion
- Almond = Over \$1.1 billion
- Berries = Over \$2.5 billion
- Canola, soybean, cotton



What Happens When Bees Decline?



Pollination and Crop Security

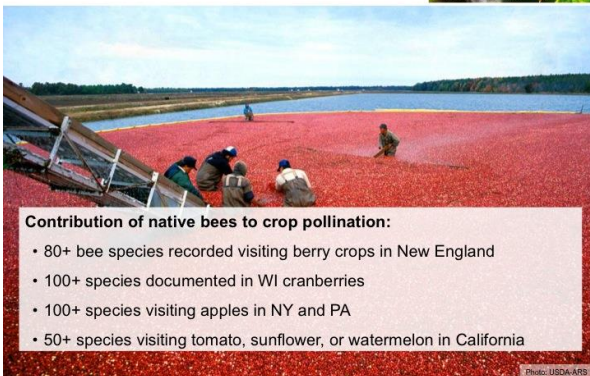


Even as bees decline, crop acreage requiring bee pollination grows.

- From 1961 to 2006 percent of global cropland requiring bee pollination rose from 18.2% to 34.9% (300% increase in total acreage)¹
- 5,000 to 10,000 new acres of Wisconsin cranberries over the next decade
- 150,000 new acres of California almonds anticipated



Native Bee Diversity in Agriculture



Contribution of native bees to crop pollination:

- 80+ bee species recorded visiting berry crops in New England
- 100+ species documented in WI cranberries
- 100+ species visiting apples in NY and PA
- 50+ species visiting tomato, sunflower, or watermelon in California

Photo: USDA-ARS

Crop Pollination: Diversity is Important



- Important to diversify pollinators for production agriculture
- Important to strengthen habitat and pesticide protection for all bees (honey and native)



Photo: Bob Hammond, CSU Coop Ext.

Native Bees Keep Honey Bees Moving

Hybrid sunflower production:

When native bees were present, the seed set in hybrid sunflower fields more than doubled.



Photos: Sarah Greenleaf

Pollinators in Peril

Threats include:
Habitat loss
Pesticides
Pests
Climate change
Invasive plants



Photo: Karra Weatheres

Four Sister Species of Bumble Bees in Decline



Bumble Bee Citizen Monitoring Project



The yellow banded bumble bee has declined from many parts of its historic range in the past decade.

Xerces citizen monitors have contributed 7 confirmed records of this species.

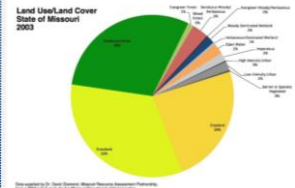
Native Bee Diversity



Threats to pollinators

Habitat

- Destruction
 - How much 'cropland' in Missouri pre 1800?
- Degradation
 - Are pastures and hayfields as beneficial as prairies?
- Not as bad as other Midwest states.....
- Ag acreage has stagnated in most of Midwest
 - Many unused small fields

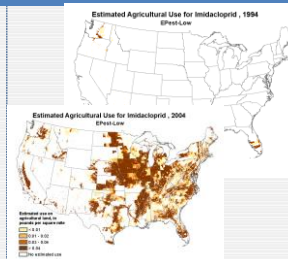


Threats to pollinators

Pesticides

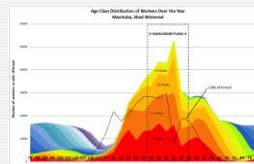
- Carson's 1967 '*Silent Spring*'
- Insecticide use has increased as has ag acres
- Still much to be determined
- Considered 2nd greatest threat

Explosion of a neonic



Pests, pathogens & diseases

Limiting pesticide use during 'honey flow' is important for 'bees and people', to prevent 'tainted honey'.



- Honey bee examples
 - *Varroa* mite and CCD
- In nature, are kept in check
 - Predators, lack of vectors, seasonal change & host resilience
- Some can be spread through flower visits
 - *Varroa* mite spread to feral honey bees

Feral honey bees- a success story

- Leo Sharashkin
- Traps feral bees
- Naturally selection has made resilient
- Discussed in M403 in the Q&A on feral bees
- Documented rebound with the NY Arnot Forest.
- Frequent moving of hive is important



On the Lookout: Rusty Patched Bumble Bee



Monarch threats

- Loss of milkweed-glyphosate resistant crops important
- Pesticide use- especially insecticides. Caterpillars are major pests of row crops.
- Climate change- harsh winters at overwintering sites
- Habitat loss at overwintering sites- logging



Conserving Missouri's Wild and Managed Pollinators

CONSERVATION AT THE INTERNATIONAL, NATIONAL AND STATE LEVELS



Objectives

1. Identify one two pollinators benefitting from international cooperation
2. Name at least one program a Missouri farmer might use.
3. Know where more land is available for pollinators- private or public?



Where's the land?

- In private hands
 - Over 90% in Missouri
 - Over 70% nationally
- Programs to motivate private landowners is critical
 - Federal
 - State
 - NGOs or other
 - Just to do the right thing



From Pure Air Natives-
Missouri CRP Seed Mixes

International organizations

- There are many
- Best when work collaboratively- NAPPC
- Some focus on conservation status
- Some are specific- Monarchs a good example where cooperation is needed- why?

Rusty patched bumble bee listing on IUCN

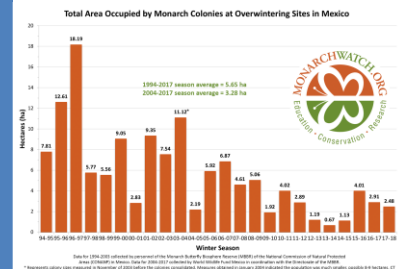


Monarch Champion

Missouri has a monarch and pollinator coordinator.

Needs to work with many groups and agencies. May differ in their politics, but united by desire for conservation.

Ag, even big ag, needs to be at the table. No milkweed, no monarchs.



Preservation in our neighbor to the South is needed. Otherwise we only have the CA and FL populations.

Conserving Missouri's Wild and Managed Pollinators

OPPORTUNITIES FOR CONSERVATION BY MISSOURI FARMS AND PRIVATE LANDS



Objectives

Best Management Practices

Management Activities for Rural or Private Lands



- Know where three great resources are to assist farmers in Missouri
- Give one example each for farmers to do which benefit pollinators.
 - Spraying of row crops
 - Mowing or haying
 - Prescribed burning

The Holy Grail.....

Small & diversified

- Typically mixed use
- Large buffer areas
- Different crops
- May integrate animals
- Often include ornamentals
- Low input lawns
- May even keep bees

Example- Liz Graznek
Happy Hollow Farm



Big Ag- has a place

Best Management Practices

Row Crop Production



IPM focus

- Utilize Driftwatch to protect honeybee hives
- Don't spray around sensitive areas, limit to herbicides if needed
- Use less neonics
- Use drift reduction nozzles
- Lower boom height and reduce pressure

Row crop country, continued

- Identify nonproductive areas to create habitat
- Edges of fields adjacent to woods or streams
 - Establish a buffer of pollinator favorable habitat
- Consider native prairie for monarchs
 - Grass waterways, filter strips, and septic drain area
 - Embankments of roads and ponds



Farm mowing, limit when & where possible

- Mow marginal areas minimally
- Consider a flushing bar
- Don't mow an area all at once, if feasible
- Leave host plants during critical times (e.g. milkweeds during bloom & after)
- Mow woody species in winter to control
- Don't mow at night

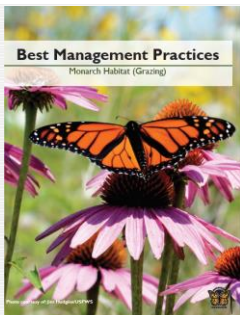


Photo courtesy of www.flushingbarproject.net



Photo courtesy of Mike Kasper

For Hay Use and Cutting, consider



- Feed hay on upland sites
- Don't feed hay on native pastures
- Cut hay as early as possible
- Delay some hay harvest until after June 15
- Cut prairie hay higher- 4"
- Leave an uncut boarder area when possible

Pastures and forages

- Follow stocking rate guidelines
- Limit dewormers and medications
- Use cattle as a tool to favor pollinator plants
- Spot treat woody plants or basal bark treat



Photo courtesy of Megan Kuehl

Animal Type	AUE
Horse	1.25
Cattle	1.25
Sheep	0.25
1,000 lb. cow	1.0
500 lb. calf	0.5
300 lb. calf	0.3
Sheep	0.2
Goat	0.17

Animal Unit
Equivalents= AUE

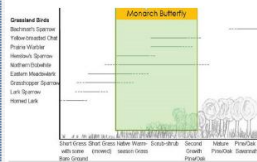
Pastures and forages

Some 'weeds' can be decent forage

Consider habitat height

		Harvest date in July	Growth Stage	Crude protein (CP)	Intake, digestible in vitro matter (IVDMI)	Neutral detergent fiber (NDF)	Acid detergent fiber (ADF)
					%		
Common lambsquarters	2	Butt	22	73	22	17	
Common lambsquarters	7	Flower	18	67	27	19	
Shepherd's purse	2	Green seed	19	55	37	29	
Shepherd's purse	7	Seed	16	53	41	34	
Pennycress smartweed	2	Flower	18	67	24	19	
Pennycress smartweed	7	Late flower	15	44	32	19	
Redroot pigweed	2	Flower	18	74	22	16	
Redroot pigweed	7	Early seed	15	73	27	20	
Yellow foxtail	2	Early seed	17	63	32	27	
Yellow foxtail	7	Seed	14	60	34	30	
Common ragweed	2	Vegetative	26	77	31	17	
Common ragweed	7	Vegetative	21	70	36	21	
Alfalfa	7	Early bloom	20	70	38	23	

Adapted from: Thomas, D.G., R.G. Harvey, K.E. Forrist, and A. Whiting. 1979. Effects of annual weed control on alfalfa forage quality. *Agrochimica Journal* 71:23-24



Rural landholders- spraying



Photo courtesy of: HEDC

- Carefully review what you are spraying & why
- Do in strips, 1/3rd at a time (annually)
- Use herbicide suppression
 - For cool season grass, time to March 15 to May 15 or Oct. 1 to Dec. 1.
- Spot treat around milkweed

Rural landholders- mechanical management

- Restrict to fall, Oct. to early November
- Speed of 8 mph or less
- Use rotary or flail mower, don't swath
- Mow 12 inches or higher
- Light disking or harrowing can be beneficial



Photo courtesy of: Brent Vandewalle



Photo courtesy of: Brent Vandewalle

Tired of mowing that big lawn?

<http://www.missouribotanicalgarden.org/Portals/0/Shaw%20Nature%20Reserve/PDFs/horticult%20ure/NLM%20Ch1.pdf>

Labor & the 'look'

Shaw Nature Reserve
Discover Nature

Labor Comparison	
Lawn - Weekly mowing	Field - Mowing once to three times per year
Highway Right-of-way - Mowing four to six times per year	Tallgrass Prairie - Mowing or burning once per year or every other year

Prairie Borders
Left to right: Seed backpack prairie landscapes with prairie dropped grass edge and split-rail fence. Corporate prairie landscape with tallgrass prairie edge. Large prairie landscape with prairie plants from the edges.

Prairie Borders
Left to right: Seed backpack prairie landscapes with prairie dropped grass edge and split-rail fence. Corporate prairie landscape with tallgrass prairie edge. Large prairie landscape with prairie plants from the edges.

Preparation for Planting

The preferred method is to use glyphosate (or Rodeo near water) to kill grasses and broadleaf weeds. Use Roundup Pro or Garlon to kill undesired tree saplings, shrubs and vines (if woody plants are too big, they must be cut down and removed from the site). Apply in mid-summer, late-summer and fall for early-winter seed sowing. Old fields typically have a diversity of grasses, broadleaf weeds and brush and require more herbicide applications than a lawn. Fields with heavy perennial and woody weeds require a two-year treatment before seeding. The table on Page 8 lists difficult weeds and suggestions for their control.



Top: Various size herbicide sprayers. Bottom: Fifty-gallon spray rig with a 15-foot boom is practical for sites larger than a half acre.

Mesic to dry prairie

Prairie Reconstruction

Sample seed mix- one acre

Season	Task	Scientific Name	Common Name	Weight Per Acre
Season 1				
Spring	Mow tall fescue repeatedly to prevent flowering and seeding.	Grasses		
Summer	Herbicide application for tall fescue using glyphosate.	Andropogon gerardii	Big bluestem	5.5 lbs.
Fall	Herbicide application for woody plants using stronger herbicide.	Elymus canadensis	Canada wild rye	12 lbs.
Late Fall	Herbicide application for woody plants using glyphosate.	Panicum virgatum	Switch grass	3 lbs.
Early winter	Microseed. Late November or early December is ideal.	Sorghastrum nutans	Indian grass	3 lbs.
Winter	Seeding can occur in January but no later.	Liatris pycnostachya	Little bluestem	16 lbs.
Season 2		Carex species (s)	Mixed prairie sedges (3 oz. ea.)	18 lbs.
Spring	Seed germination in April. Survey seedlings to determine seedling density and weediness. Begin mowing seeded area every two weeks if annual weeds appear. Spot spray perennial weeds.	Total Grasses		37.5 lbs. or 3.5 lb.
Summer	Continue mowing every 2-3 weeks. Spot spray perennial weeds.	Forbs		
Fall	Continue mowing every 3 weeks. Spot spray perennial weeds.	Asclepias tuberosa	Butterfly milkweed	8 lbs.
Season 3		Aster novae-angliae	New England aster	2 lbs.
		Ragwort	White false holly	14 lbs.
		Coreopsis tinctoria	Lance leaved coreopsis	2.5 lbs.
		Coreopsis rostrata	Tall coreopsis	4 lbs.
		Echinacea pallida	Pale purple coneflower	8 lbs.
		Eryngium yuccifolium	Rattlesnake master	4 lbs.
		Heliopsis helianthoides	False sunflower	4 lbs.
		Heliopsis scaberrima	Western sunflower	1 lb.
		Lepachys capitata	Round head bushclover	3 lbs.
		Liatris pycnostachya	Prairie blazing star	7 lbs.
		Monarda fistulosa	Wild bergamot	1.5 lbs.
		Rudbeckia hirta	Gray headed coneflower	1 lb.
		Rudbeckia hirta	Black-eyed Susan	1 lb.
		Solidago rigida or speciosa	Stiff or showy goldenrod	2.5 lbs.
		Rudbeckia subtomentosa	Sweet coneflower	1 lb.
		Veronica spp.	Veronica	2.5 lbs.
		Tradescantia virginiana	Spotted plantain	1 lb.
		Grand Total		88.5 lbs. or about 4.5 lb. 8 lbs. PLS per acre

Dry Savannah to Open Woodland

Habitat Reconstruction

Sample seed mix- one acre

D. Is the site suitable for a tallgrass prairie? Look for evidence that a prairie existed on the site. Are there stories about prairies in the area? Do prairie plants exist in the area? If there are trees, the site may have been prairie anyway. Much of the tallgrass prairie south of the Missouri River has been replaced with forest over the past 200 years. If you have attractive specimen trees, consider seeding the site with savanna species. They are more tolerant of shade and drought.

See sample seed list for savannas on page 13.

Scientific Name	Common Name	Weight Per Acre
Grasses		
Andropogon gerardii	Big bluestem	5.5 lbs.
Carex species (s)	Mixed prairie sedges (3 oz. ea.)	18 lbs.
Chamaenerion latifolium	River oats	4 lbs.
Quercus alba	White oak	16 lbs.
Bromus pinnatus	Woodland brome	4 lbs.
Bromus tectorum	Barbours grass	4 lbs.
Elymus virginicus var. glaberrimus	Woodland rye	4 lbs.
Panicum virgatum	Switch grass	3 lbs.
Total Grasses & Sedges		56 lbs. or 5.5 lb.
Forbs		
Aster patens or A. multiflorus	Purple daisy, prairie aster	3 lbs.
Asclepias tuberosa	Butterfly milkweed	8 lbs.
Coreopsis tinctoria	Star coreopsis	2.5 lbs.
Echinacea purpurea	Purple coneflower	12 lbs.
Heliopsis helianthoides	False sunflower	4 lbs.
Liatris pycnostachya	Savanna blazing star	7 lbs.
Monarda fistulosa	Garden phlox	1.5 lbs.
Rudbeckia hirta	Brown-eyed Susan	1 lb.
Rudbeckia hirta	Reary skullcap	4 lbs.
Solidago rigida or speciosa	Wild aster	12 lbs.
Tradescantia virginiana	Woodland goldenrod	3 lbs.
Veronica americana or V. repens	Other spiderwort	4 lbs.
Tradescantia virginiana	Yellow spiderwort	3 lbs.
Tradescantia virginiana	Golden Alexander	1 lb.
Tradescantia virginiana	Golden Alexander	3 lbs.
Grand Total		88.5 lbs. or 5 lbs. 8 lbs. PLS per acre

Seeding by Hand/ Annual Mowing



Sowing seed can be done by hand if the site is less than five acres. Use a commercial seed drill for larger plots. Turn people can sow seed over five acres in a morning.



Six-week-old prairie seedlings: Wild Bergamot, left, and Prairie blazing star.



Top: First year prairie receiving mowing. Bottom: Established prairie receiving annual late winter mowing.

Prescribed burns have their place

Burn no more than 1/3 per year

Late spring burning will favor forbs

Early spring favors cool season grass

Timing for warm season grass habitat is different than cool season grass

Attend a state sponsored workshop and have a plan before conducting

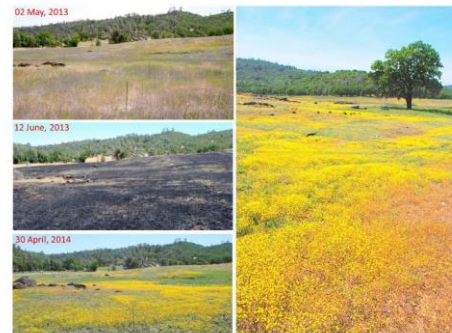
The following prescribed burn quick reference table provides management-focused prescribed burn timing guidance for cool and warm season forages.

Management Objective	For Cool Season Grass	For Warm Season Grass
Control cool season grass		
Control warm season grass		
Control forage for horses		
Control forage for cattle		
Control forage for sheep		
Control forage for goats		
Control forage for deer		
Control forage for wild turkeys		
Control forage for wild geese		
Control forage for wild ducks		
Control forage for wild swans		
Control forage for wild geese		
Control forage for wild ducks		
Control forage for wild swans		
Control forage for wild turkeys		
Control forage for wild geese		
Control forage for wild ducks		
Control forage for wild swans		

Legend: Cool season grass activity (Red), Warm season grass activity (Blue)

Photo courtesy of Brent Landhardt

Example- favors wildflowers & forbs



What did we overlook.....

Support your parks and conservation areas

- Missouri maintains many great habitats
 - State Parks
 - Conservation Areas
 - National Forests
 - County and City Parks
 - What else



Marginal lands & vacant lots

- Can be great habitat
 - Feral honeybees like rusty old cars or broken down buildings
- Pollinators like weeds
- Skippers are 1st of pollinators returning to disturbed sites

Conserving Missouri's Wild and Managed Pollinators

CONSERVATION OPPORTUNITIES IN MISSOURI GARDENS AND RESIDENTIAL LANDSCAPES



Objectives

1. Name an attribute common with annuals that restricts pollinators
2. Describe a vital seasonal role trees play
3. Know how to find quality herbaceous perennials
4. Identify the two plant resources needed for butterflies and moths
5. Name the vegetable family most attractive to bees
6. Describe the benefits of a low care lawn approach

Gardeners play a vital role.

The saying goes, we can't save polar bears with our backyard habitat changes, but we can make a difference with pollinators. Some inhabit a small area and can get by with just the floral resources a typical garden supplies.



Once thought to stifle biodiversity, urban and suburban areas are now seen to have the potential to host a variety of pollinators.

Overview- Landscape & gardening

- Diverse floral and nesting arrangements are beneficial
- From trees, to bushes, to perennials to annuals, lawns and even marginal or ignored areas all contribute
- Variation in plant height is a big plus



Annuals

- Many annuals are of



Photos by James Quinn

- What pollinator makes you satisfied?

Annuals, cont.

- Industry recognizes they need to more (or there's an opportunity)
- Trials are being done
- Single flowers are better than double
 - Zinnia
 - Marigold
 - Moss rose
 - Cosmos
 - Sunflower



Perennials

Include at least three species in bloom in spring, summer and fall.



In small areas, plant single species together to increase visibility to pollinators and increase foraging efficiency.



- Some of the best for floral resources
- The list is long
- And complicated- how to arrange, integrate or maintain
- Which do you want?
- There can be ugly times
- Where does one get good information?

Perennials

- Full sun is often best
- Can be expensive
 - Starting from seed is cheaper
 - But takes more time & weed control a problem
- Native plants are often better
- Which plants are better?
- And what does 'better' mean?



Research on perennials

In Pennsylvania the pollinator program is under Master Gardeners



- Year to year variation
- How to evaluate?
 - Total visits by pollinators.....or
 - Diversity of pollinators attracted?
- Are named cultivars or selections better or worse?
 - Somewhat poorer
 - But difference inconsistent & not that significant

Backyard habitat for monarchs

Key items:

- Size
- Exposure
- Drainage & soil type
- Shelter
- Food
 - for caterpillars
 - nectar for butterfly

PLANTING DIAGRAM EXAMPLES

Dry Soil Conditions (Well-drained Soil)

Requirements:

- Minimum 100 square feet
- Minimum 10 individuals of one or more species
- Minimum 4 monarch or monarch native species for nectar

Dry Conditions Planting Diagram:

- 100 square feet
- 5 each of five different milkweeds
- 10 groups of four different monarch/pontential native species
- Total 20 plants of approx 10' apart

Legend:

- (S-710) Purple Milkweed
- (S-810) Butterfly Milkweed
- (S-1000) White Purple Queen
- (S-1800) Rough Winged Star
- (S-1900) Milk Buttercup
- (S-1800) Black-eyed Susan

Wet Soil Condition (Poorly Drained Soil, i.e. Raingarden)

Requirements:

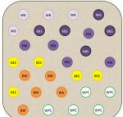
- Minimum 100 square feet
- Plant more than 10 plants if using only one species of milkweed
- Minimum 4 monarch or monarch native species for nectar

Wet Conditions Planting Diagram:

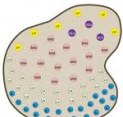
- 200 square feet
- 15 of one milkweed species
- 40 groups of different monarch/pontential native species
- Total 64 plants, 24 spaced 24" apart within 100 square feet, 40 spaced 10' apart within 100 square feet

Plant Legend:

- (S-1800) Marsh Milkweed
- (S-1800) New England Aster
- (S-1800) Gay Plant
- (S-1800) Black Lobelia
- (S-1800) Culver's Root



Dry condition planting example



Wet condition planting example

My 1st attempt, summer of 2018 with swamp milkweed (is it more attractive than common milkweed?)



Four plants, transplanted in early June, produced numerous monarch caterpillars and many pollinators loved it!

Photos by James Quinn

Don't forget the herbs

- Basil
- Borage
- Chives
- Cilantro
- Dill
- Fennel
- Lavender
- Mint
- Oregano
- Sage



Vegetables



- Often harvest veggies before flower
- Several are self pollinated (tomatoes) but pollinators may visit
- Nothing brings them in like the Cucurbits!!
- Plant gourds
- Remember to include cover crops, like buckwheat if possible

Photo by James Quinn

Lawns- doing less is doing more!

- Besides not using insecticides.....
- Fertilize less
 - Grass thins out so...
- Tolerate 'perceived weeds'
 - Clover
 - Dandelions
 - Henbit
 - Violets



How many pollinator plants
Do you see? Photo by James Quinn

Lawns- highlight on microclover



- For those wanting a more manicured lawn
- Shorter growing 'white' clover (Dutch clover)
- Fixes nitrogen &
- Holds blooms lower
- More left after mowing
- Benefits pollinators
- Clover will tolerate some herbicides, to keep other weeds in check

Lawns- Eco-lawn mixes

- Might be low care or water efficient
 - E.g. buffalo grass
- Some blends introduce flowers
 - (simplest) microclover
 - Other low profile flowers
 - ✦ Sweet alyssum
 - ✦ Baby blue eyes
 - ✦ White yarrow

Fleur de Lawn
Inspired by natural
Lawns of NE
Countyside.
PT Lawn Seed,
Portland, OR



Trees & Shrubs- key benefits



Tulip tree
Flower
Bonsak
Hammeraas,
Bugwood.org

Yellow trumpet
vine. Photo by
James Quinn



- Lots of flowers, nectar and or pollen at once
- Great source early season
- Needed source late season- limited, examples
 - Bee bee tree, wolf berry, & Devil's Walking stick
- There are so many-
 - Some you likely have!
 - See sidebar page 15
- Lot's of lists...where's some research?

Trees & Shrubs, continued

- Note Table 3 on pg 15
- Which do you have?
- Could you plant others?
- List based on research of pollinator counts on woody ornamentals from Kentucky
- Most are OK in Missouri, many are native plants
- Avoid double petal forms!



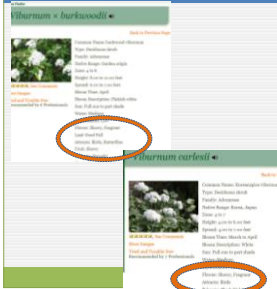
Goji or wolf Berry. One ugly shrub but pollinators love it !



Photos by James Quinn

Careful with similar names

Viburnum



Hydrangea



Hydrangea paniculata, also called Panicle, has a cultivar 'Grandiflora', Considered desirable to pollinators

Trees- Special focus, orchards

Only spray fungicides when in flower
Limit insecticide sprays to just what's needed
Spray in the evening or early morning, and when calm
Consider artificial habitat for orchard bees



Agroforestry- trees & shrubs

Riparian forest buffers

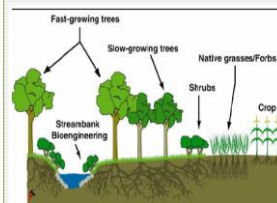


Figure 2. Selecting the appropriate species for a riparian buffer will help ensure its success and longevity. (Source: Schultz et al. 2009.)

Windbreaks & hedgerows



Integrate windbreaks into an overall landscape design to achieve multiple objectives.

Agroforestry- mixed use

Silvopasture



Cattle graze among Missouri pecan trees in this well-managed silvopasture practice.

Alley cropping



Bluegrass hay is harvested between rows of pecan trees in this alley cropping example, Shepherd Farm, Clifton Hill, Mo.

Agroforestry- forest farming

Overstory

- Tulip or yellow poplar
- Maple
- Basswood
- Black cherry

Understory

- Ginseng
- Goldenseal
- Black cohosh (with nearby)
 - Pale touch-me-not
 - Whiteflower leafcup

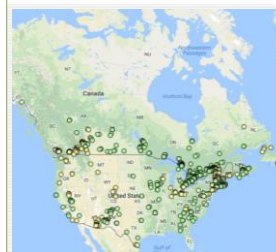
The Master Pollinator Steward Program

CITIZEN SCIENCE, CONCLUSION, REVIEW OF COURSE AND EVALUATION

Or, knowing what you know now,
what are you going to do with it?

And what will you say to others
about this program?

Citizen science



Checklists with Painted Lady reports in eButterfly during 2017

- Bumblebee Watch
- The Great Sunflower Project
- BeeSpotter
- e-Butterfly
- Monarchs
 - Journey North
 - Monarch Watch
 - Monarch Larvae Monitoring Project

From my garden- results on August 1st, 2018

ADD A COUNT

Submitting Stationary observation made moments ago at 703 W Broadway, Columbia MD

Observation

Pollinator species	Count
Bumblebee(s)	1
Capeweed bee(s)	1
Western Honey bee(s)	1
Other bees (describe in notes)(s)	1
Unknown bee(s)	2
Beet(s)	1
Butterfly (Lepidoptera)(s)	1
Unknown bird(s)	1
Unknown bird(s)	1
Unknown bird(s)	1

[LEARN ANOTHER POLLINATOR SPECIES](#)

Click / save another for each species observed.

Increment the counter to indicate how many of each species.

☐ I did not see any pollinators.

Check this box if you made an observation but saw zero pollinators.

How to do

How to count pollinators on a single day

1. Identify the pollinators that are visiting your plants.

2. Count the number of each species that is visiting your plants.

3. Record the count for each species in the appropriate box on the form.

4. Submit the form to the project website.

5. Repeat the process for each day of observation.

6. Review the data and share it with the project team.

7. Use the data to inform conservation efforts.

8. Thank the project team for their support.

9. Share the results with your community.

10. Repeat the process for the next day.

Bringing it home with the Birds!!

What is conservation?
One part of nature? Or all the parts?

What's the most famous citizen science project?

How about Audubon's annual Christmas Bird Count?

What does it accomplish?



Photo by James Quinn