Pollinators and Plants: Rewilding our Gardens for Bees, Birds and other Wildlife

Edward M. Spevak, Ph.D. Director-Saint Louis Zoo WildCare Institute Center for Native Pollinator Conservation

Saint Louis Zoo

Land Acknowledgement

We would like to acknowledge that the Saint Louis Zoo is located on the traditional, ancestral, and unceded territory of the Osage Nation and the Illini Confederacy. We also acknowledge that this area and parts of Missouri had been traditionally used by others including the Pawnee, Sac and Fox, Dakota, Lakota, Otoe, Missouria, Omaha, Ioway, Quapaw, Chickasaw, Kickapoo and the Haudenosaunee. The process of knowing and acknowledging the ground beneath our feet is a way of honoring and expressing gratitude for the people on this land before us. It familiarizes visitors with the cultures and histories of Missouri's indigenous tribes, as well as with their ties in the St. Louis region. We honor our heritage of Native Peoples and what they teach us about stewardship of the earth.

Pollinators: Ecological Keystone Species

Around 90 percent of flowering plants (~400,000 sp.) depend to some extent on animal pollination.











bees (see tree on left) (Blitzer et al. 2015).

It's About Bee Diversity not Bee Abundance







































Biodiversity Loss: Native Bees and Pollinators are in Trouble

>Loss of Habitat and Fragmentation

>Invasive Plant Species >Changes in Agricultural **Practices**

Misuse of Pesticides Disease and Parasites **≻**Pollution

>Competition with **Introduced Species**

Interaction Disruption

Climate change is affecting ranges globally. Here ants are invading and consuming wildlife in cloud forest never before exposed to these marauders.

Nitrification

Fertilizer and products of fossil fuels combustion are nitrifying the planet, challenging the biotas adapted to low-nutrient. conditions.

Fire Global warming elevates fire risk. Fires in Australia. Amazonia, and California burned an unprecedented >5 million hectares of forest in 2019.

Storm Intensity

flooding.



DEATH BY A THOUSAND CUTS GLOBAL THREATS/TO INSECTS

Pollution

Chemical, light, and sound pollution of water, air, and soil are impacting plant and animal life. worldwide.

Urbanization

Our global population of 7.8 billion. spread planet-wide, comes at great cost to biodiversity and wildlands. Already, over 500 vertebrates have been driven to extinction.

Introduced Species

Global trade is accelerating the movement of pernicious plants, animals, and pathogens to new regions-often with devastating consequences.



Agricultural

Intensification

Industrialized agriculture, with

Deforestation

The tropics lost 11.9 million hectares of forest in 2019, mostly to agriculture.

Insecticides

Modern, industrialized agriculture, with its increasing reliance on chemical insecticides, has led to chronic contamination of wildlands and impacts to non-target insects.

Global Warming

Arctic sea ice is declining precipitously, arctic-alpine and other cold-adapted communities are contracting, while sea-level rise threatens coastal ecosystems.

Droughts

Periods with diminished

Climate changes bring stronger, more frequent storms and hurricanes: more fire-igniting lightening; and damaging

Massive Insect Decline Threatens Collapse Of Nature

Percentage decline in selected global insect populations over the past decade



BIODIVERSITY

Biodiversity Loss is termed as a decrease in biological diversity within a species, ecosystems, places, and the earth as a whole. If there is a loss of a species in a given area or a loss in the number and genetic variability of any area, it is often described as a loss in Biodiversity.

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Nature positive means "ensuring more nature in the world in 2030 than in 2020 and continued recovery after that" (https://www.nature positive.org/)

Global Goal for Nature: Nature Positive by 2030



Despite the current dire circumstances, the world ecology resource Nature+Positive forecasts what can happen to Earth's ecosystem if rewilding and other sustainability efforts kick in by 2030. Source: <u>NaturePositive.org</u>



"To restore stability to our planet, therefore, we must restore its biodiversity, the very thing we have removed. It is the only way out of this crisis that we ourselves have created. We must rewild the world!"

Sir David Attenborough



"We must rewild the world."

"Rewilding the world is easier than you think. A century from now our planet could be a wild place again." ~Sir David Attenborough Rewilding.org

Global Charter for Rewilding the Earth

We Can Rewild

Rewilding means helping nature heal. Rewilding means giving space back to wildlife and returning wildlife back to the land, as well as to the seas. Rewilding means the mass recovery of ecosystems and the life-supporting functions they provide.



What is Urban Rewilding?

Rewilding, returning your landscape back to nature, is possible for even the most urban of environments. Stepping back and allowing natural processes to occur – in the process reducing management of your yard – you can encourage wild plants and insects to return. Rewilding begins with recognizing native plants as the basis of the local food web that is essential for populations of native insects and other wildlife.



"We forget, in a world completely transformed by man, that what we're looking at is not necessarily the environment wildlife prefer, but the depleted remnant that wildlife is having to cope with"

- Isabella Tree, Wilding



The 3Ds of Rewilding

DiversityDispersalDisturbance



The new 3Cs of Rewilding

CoresConnectivityCo-Existence



ECOS 42 (3): Time to put the wild back into rewilding https://www.ecos.org.uk/time-to-put-the-wild-back-into-rewilding/

Tips to Rewild your Home for Pollinators and Other Wildlife (3 Ds and the 3 Cs)



Diversity and Cores

- 1. Create Core Habitats
 - a. Plant Native Plants, Trees and Shrubs
 - b. Provide Nesting Sites
- 2. Eliminate Pesticides
- 3. Reduce or Eliminate Lawns
- 4. Think about Time
 - a. Day -Turn off the Lights
 - b. Seasons
 - c. First Year it Sleeps
- 5. Restore Ecosystem Functions and Keystone Species

II. Disturbance

Ι.

- 1. Forget Tidy
- 2. Leave the Leaves and Move the Leaves
- **III. Dispersal and Connectivity**
 - 1. Corridors and Community

IV. Coexistence

- 1. Educate your Neighbors/ Intentionality and Acceptance
- 2. Educate Yourself
- V. ReWild your Thoughts

Diversity and Cores

Create Core Habitats Plant Native Flowers, Trees and Shrubs

Benefits

- Enhance native biodiversity
- Providing pollen and nectar resources for pollinators
- Re-creation of native habitats Adapted to local climate







Avoid Cultivars and Double Blossoms





Xerces Society

Purple coneflower (*Echinacea purpurea*) has been bred into more than 100 cultivars. Shown clockwise: the straight species, 'green jewel' which is much less visible to pollinators, 'pink double delight' is a sterile cultivar that doesn't produce pollen and whose nectar is inaccessible, 'magnus' which is more densely flowered but otherwise little changed from the straight species

Plant a diversity of plants with different flower shapes, sizes and colors

















Pollinator diversity maximized when 15 to 25 flower species are present



Create Floral Targets or Repeat Plantings

 Many bee species feed on only a single plant species during a foraging trip

•Plant clumps of single species within larger diverse plantings are most effective

 Repeat plant species throughout landscape for natural foraging

Don't Forget Trees and Shrubs



Red Maple (Acer rubrum)



Crab Apple (Malus sp.)



Red Bud (Cercis canadensis)



Willow (Salix sp.)



Black Chokeberry (*Aronia melanocarpa*)

Trees and Shrubs Provide Fruit for Wildlife and You

Crab Apple (Malus spp.) Chokecherry, (Prunus virginiana), Black Cherry (Prunus serotina), Wild Plum, American Plum, (Prunus americana), Chickasaw Plum (Prunus angustifolia)



Blueberries (*Vaccinium* spp.)



Serviceberry, Shadberry, Shadbush, Juneberry (*Amelanchier* spp.)



Chokeberry (Aronia spp.)



Create Core Habitats Provide Nesting Sites



Ground-nesting bees (solitary)



Twig/Tunnel-nesting bees (solitary)

Ground Nesting Bees

• Approximately ~70% (or 3,000 species in North America)

Virescent Green Metallic Sweat Bee





Ground Nesting Bees

 From above ground bee nests resemble ant hills

 May be found in turf, more often on bare, exposed ground

•Nests may be a deep as three feet
Virescent Green Metallic Sweat Bee

Squash Bee

Hibiscus Bee

Mining Bee

Sunflower Bee

Create a "Bee Bed"







Twig/Tunnel Nesting Bees

Twig/Tunnel-nesting bees:

• Approximately ~30% (or almost 1,000 species in North America)

 Hollow stems and beetle borer holes Retain or create tunnels:

- Protect snags wherever possible
- Provide artificial nests

































Eliminate Pesticides



Natural Pest Control: Hover Flies



Half-Lawn and Half-Yard for Half-Earth

Turf grass is the largest irrigated crop in the U.S. covering an area of almost 50 million acres, combined larger than the state of Missouri.



Create a Flowering Bee Friendly Lawn







2) Raise mower height, preferably 4" or greater



Helping Pollinators: Bee Lawns









While non-native flowers may be aggre they can still be very useful. Jutch white clover (Trifollum repens) and eeping thyme (Thymus unrovilum) are two pecies that benefit pollinators and will flower in mowed lawn.

White clover provides additional nitrogen and tolerates drought, making it easy to grow in low Dandelions and Creeping Charlie also benefit

pollinators but are very aggressive and typically not favored by homeowner

Planting a bee lawn is best in late fall as a dormant seeding, ideally when soil mperatures dip below 40°F. rmination will not occur until the follow pring when soil temperatures rise above 501 formant seeding reduces pressure from urrounding weeds that may be competing for



tering: Soil moisture should be monitore White clover and fine feacue grasses are quite drought-tolerant but may need supplementa ing after several weeks with no rain Fertilizing: A soil test (visit soiltest.cfans.umn achil will datarming if outriants need to be added Fertilizer requirements will be minimal if clippings

MANAGING BEE LAWNS

are returned, mowing heights are kept high, and soil quality is good. Weeding: Hand weeding is the preferred opi with spot treatments with selective herbicic as needed. Learn which weeds have value pollinators, are diverse and add to a long wering season for bees and other pol

Visit Bee Lawn Demo/Trial Plots at the Minnesota Landscage Arboretum, Incated near the shrub garden collection along Three-Mile Drive.

FOR MORE INFORMATION University of Minnesota Landscape Arboretun Iniversity of Minnesota Bee Lab

beelab.umn.edu/bee University of Minnesota Turfgrass Science University of Minnesota Extension Mary Meyer, Maria Spivok, Eric Wotkins and J JAN UNIVERSITY OF MINNESOTA EXTENSION

https://www.beelab.umn.edu



Flowering Plants

Think about Time. Day/Night -Turn off the Lights

	1	Fatal attraction	Illuminated skyscrapers and spotlights can lure migrating birds. Animals may become disoriented and end up in deadly collisions or perish from exhaustion.
	2	Dining by streetlight	Streetlamps, floodlights, and other luminous objects attract a wide range of insects at night. Predators home in on light-loving swarms to take advantage of the congregated prey.
	3	Lonely nights	Nighttime lighting drives away some nocturnal pollinators, reducing the ability of plants in lit areas to bear fruit.
	4	Shifting communities	Artificial illumination at night can increase the proportion of microorganisms in freshwater sediments that are able to photosynthesize under low light levels.
	5	Desynchronized	Artificially lit nights can perturb an animal's and plant's circadian rhythms, altering the timing of activities, such as sleep, foraging, mating, and migration, that are tightly controlled by the body's internal clocks.



Annika K. Jägerbrand, Kamiel Spoelstra Effects of anthropogenic light on species and ecosystems. Science 380, 1125-1130 (2023). DOI: 10.1126/science.adg3173



Firefly courtship in dark habitats







Firefly courtship in areas with light pollution







ww.areenhumour.cor

Avalon C.S. Owens, Précillia Cochard, Joanna Durrant, Bridgette Farnworth, Elizabeth K. Perkin, Brett Seymoure, Light pollution is a driver of insect declines, Biological Conservation, Volume 241, 2020, 108259, ISSN 0006-3207, https://doi.org/10.1016/j.biocon.2019.108259.

Replace Outdoor Lights with Yellow LED Lights Turn off Outside Lights, Install Motion Sensors, Redirect Lights



We would need to plant 875 million trees every year to offset the waste Source: DarkSkies.org





How to limit light pollution





Use more amber or lower-temperature (such as 2,700 Kelvin) LED bulbs

Blackout curtains can prevent outside light from entering your home





Apply motion detection or dimming to light fixtures

Hooded street lamps can help direct and contain light



Use timers or dimmers on lights

Support Night Pollinators: Moth Gardening



Think about Time. Seasons

Plant for a Succession of Blooms

Minimum of 3 blooming species throughout the year (Spring, Summer, and Fall)

Pronounced seasonality among bees:

Number of species in flight THROUGHOUT the growing season (April-October): approximately 40 (some Hylaeus, Augochlora, Augochlorella, Halictus, Agapostemon, Lasioglossum, Ceratina, Bombus)

Number of seasonally-limited species = the vast majority
Number of species in flight ONLY in April/May = 82 (e.g., Osmia)
Number of species in flight ONLY August/September = 49
(e.g.,Melissodes)



General	Bee	Garden	Planting	Guide	- Bloom	Times
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Common Name	Scientific Name	March	April	May	June	July	August	Sept	October
Red Maple	Acer rubrum	Х	Х						
Pussy Willow	Sailix discolor	Х	Х						
Redbud	Cercis canadensis	Х	Х						
Serviceberry, June Berry, Shadbush	Amelanchior arborea	Х	Х	Х					
Wild Plum	Prunus americana	Х	Х	Х					
Crab Apple	Malus sp	Х	Х	Х					
Virginia Bluebells	Mertensia virginica	Х	Х	Х					
Chokeberry	Aronia sp.		Х	Х					
Black Cherry	Prunus serotina		Х	Х					
Daisy Fleabane	Erigeron sp.		Х	Х	Х	Х	Х	Х	Х
Golden Currant	Ribes odoratum		Х	Х	Х				
Columbine	Aquilegia canadensis		Х	Х	Х				
American Holly	llex opaca			Х					
Wild Hydrangea	Hydrangea arborescens			Х	Х	Х			
Bee Balm/Horsemint	Monarda sp.			Х	Х	Х			
Coneflowers	Echinacea sp. & Ratibida sp.			Х	Х	Х	х	Х	
Blue Wild Indigo	Baptisia australis			Х	Х				
Black Haw	Vibumum prunifolium			Х	Х				
Penstemon/ Beardtongue	Penstemon sp.			Х	Х				
Missouri Primrose	Oenothera macrocarpa			Х	Х				
New Jersey Tea	Ceanothus americanus			Х	Х				
Bugleweed	Ajuga reptans			Х	Х				
Lambs Ears	Stachys byzantina			Х	Х	Х			
Milkweeds	Asclepias sp			Х	Х	Х	X	Х	
Yellow Crownbeard	Verbesina helianthoides			Х	Х	Х	Х	Х	
Catmint/Catnip	Nepeta cataria			Х	х	Х	Х	Х	
Coreopsis	Coreopsis sp.	Coreopsis sp.		Х	Х	Х	Х	Х	
Russian Sage	Perovskia atriplicifolia			Х	Х	Х	Х	Х	Х
Rose Verbena	Glandularia canadensis		Х	Х	Х	Х	Х		
Prairie rose	Rosa sp				Х	Х			
Purple Poppy Mallow	Callirhoe involucrata				Х	Х			
Rosemary	Rosmarinus officinalis				Х	Х			
Fennel	Foeniculum vulgare				Х	Х			
Prairie Clover	Dalea sp.				Х	Х			
Lead Plant	Amorpha canescens				Х	Х			
Basswood	Tilia americana				Х	Х			
Shrubby St John's Wort	Hypericum prolificum				Х	Х	Х		
Black-eyed Susan	Rudbeckia sp.				Х	Х	Х		
Culver's Root	Veronicastrum virginicum				Х	Х	Х		
Thyme	Thymus sp.				Х	Х	Х		

Life Cycle of a Bumble Bee Colony



Winter

Fall



Spring









Restore Ecosystem Functions and Keystone Species



"The rewilding of natural ecosystems that fascinates me is not an attempt to restore them to any prior state, but to permit ecological processes to resume...Rewilding recognizes that nature consists not just of a collection of species but also of their ever-shifting relationship with each other and with the physical environment"

> George Monbiot Journalist

90% of all insects that eat plants require native plants to complete their development.



Sustain Wildlife with Native Plants

Douglas W. Tallamy With a Foreword by Rick Darke

The Caterpillar Connection

96% of North American land birds feed their young with insects, including caterpillars.





Nest Location

2. Oaks (Quercus sp.)

(Robinia pseudoacacia)

This map shows the relative amount of time chickadees spent foraging in different tree species in and around a Washington, D.C. yard. Ignoring nonnatives close to the nest—yellow star—the birds preferred to fly farther to natives such as American elm, black cherry and oak. Map created using ArcGIS® software by Esri.

Nonnative plants reduce population growth of an insectivorus bird. Desiree L. Narango, Douglas W. Tallamy, Peter P. Marra. Proceedings of the National Academy of Sciences. Nov. 2018, 115 (45) 11549-1554

Nonnative Plants Reduce Population Growth in Carolina Chickadees

Most songbirds need thousands of insects to reproduce & survive

Number of Young

Smithsonian Conservation



When yards have

nonnative plants, bird prey & reproduction declines

Mostly Nonnative Mostly Native Plants Plants Only yards with more than native plant

sustain chickadee populations @DLNarango

Narango, DL, Tallamy, DW, and Marra PP. Nonnative plants reduce population Funded NST growth in an insectivorous bird. Proceedings of the National Academy of Sciences by

PeterPMarra

ØSMBC

"To create bird habitat at home-aim for more than 70% native plant foliage."

Dr. Desiree Narango, research scientist at UMass Amherst, found that in order for chickadees to find the 6,000 to 9,000 caterpillars they need to raise their young, 70% of the plant foliage within 50 yards of their nest must be native to the area.

Nonnative plants reduce population growth of an insectivorous bird. Desiree L. Narango, Douglas W. Tallamy, Peter P. Marra. Proceedings of the National Academy of Sciences. Nov. 2018, 115 (45) 11549-1554

Support Butterfly and Moth Caterpillars

Plant "Keystone" Plants: Trees and Shrubs

Keystone Plant = Host Plant

https://homegrownnation alpark.org/keystonetrees-and-shrubs/

Common Name	Plant Genus	Butterfly/moth species supported
Oak	Quercus	534
Black cherry	Prunus	456
Willow	Salix	455
Birch	Betula	413
Poplar	Populus	368
Crabapple	Malus	311
Blueberry	Vaccinium	288
Maple	Acer	285
Elm	Ulmus	213
Pine	Pinus	203
Hickory	Carya	200
Hawthorn	Crataegus	159
Spruce	Picea	156
Alder	Alnus	156
Basswood	Tilia	150
Ash	Fraxinus	150
Rose	Rosa	139
Filbert	Corylus	131
Walnut	Juglans	130
Beech	Fagus	126
Chestnut	Castanea	125

Support Butterfly and Moth Caterpillars

Plant "Keystone" Plants: Wildflowers

Keystone Plant = Host Plant

Common Name	Plant Genus	Butternly/moth species				
Common Name		supported				
Goldenrod	Solidago	115				
Asters	Aster	112				
Sunflower	Helianthus	73				
Joe pye, Boneset	Eupatorium	42				
Morning glory	Ipomoea	39				
Sedges	Carex	36				
Honeysuckle	Lonicera	36				
Lupine	Lupinus	33				
Violets	Viola	29				
Geraniums	Geranium	23				
Black-eyed susan	Rudbeckia	17				
Iris	Iris	17				
Evening primrose	Oenothera	16				
Milkweed	Asclepias	12				
Verbena	Verbena	11				
Beardtongue	Penstemon	8				
Phlox	Phlox	8				
Bee balm	Monarda	7				
Veronica	Veronica	6				
Little bluestem	Schizachyrium	6				
Cardinal flower	Lobelia	4				

Start a new **HABIT**AT[®] NATIONAL PARK

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Tree & Shrub examples

Quercus macrocarpa

Prunus americana

Populus deltoides

NO

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9.2 Temperate Prairies

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https://homegrownna tionalpark.org/keysto ne-trees-and-shrubs/





Lot nation to unstant half of

Support Butterfly and Moth Caterpillars and Pollen Specialist Bees



Garden for Wildlife



https://www.nwf.org/Garden-for-Wildlife/About/Native-Plants/keystone-plants-by-ecoregion


Keystone Native Plants Eastern Temperate Forests - Ecoregion 8

Native plants have tight relationships with wildlife, formed over many thousands of years, providing natural sources of food, cover and places to raise young. Without healthy native plant communities, wildlife cannot survive. Every ecoregion has different native plant communities.

Keystone plants are native plants critical to the food web and necessary for many wildlife species to complete their life cycle. Without keystone plants in the landscape, butterflies, native bees, and birds will not thrive. 96% of our terrestrial birds rely on insects supported by keystone plants.

There are two types of keystone plants:

- W Host plants that feed the young caterpillars of approximately 90% of butterflies and moths (Lepidoptera).
- Plants that feed specialist bees who only eat pollen from specific plants. Keystone plants for native bees feed both specialist and generalist bees.

Entomologist Dr. Doug Tallamy, and his University of Delaware research team have identified the keystone plants that support butterfly and moth species. Native host plants of pollen specialist bees were researched by pollinator conservationist Jarrod Fowler.

Top Keystone Plant Genera in Eastern Temperate Forests - Ecoregion 8

A genus is a taxonomic category of plants that contains one or more species of plants with similar characteristics. Species within each genus have adapted to local conditions and are the appropriate native species or varieties suited to a specific ecoregion.

Plant Type	Plant Genus	Sample of Common Species (not all encompassing)	# Caterpillar Species that Use this as a Host Plant	# of Pollen Specialist Bee species that Rely on this Plant
Trees	Quercus	White oak (Quercus alba), Black oak (Quercus velutina)	936 😽	
-	Prunus	American plum (Prunus americana), Black cherry (Prunus serotina), Chokecherry (Prunus virginiana)	340 🦋	
	Betula	River birch (Betula nigra), Sweet birch (Betula lenta)	284 😽	
	Populus	Eastern cottonwood (Populus deltoides)	249 😽	
	Acer	Box elder (Acer negundo), Silver maple (Acer saccharinum), Sugar maple (Acer saccharum)	238 😽	
	Malus	Southern crabapple (Malus angustifolia), Sweet crabapple (Malus coronaria)	237 😽	
	Carya	Bittemut hickory (Carya cordiformis), Pignut hickory (Carya glabra), Mockemut hickory (Carya tomentosa)	2.13 💓	
	Pinus	Pitch pine <i>(Pinus rigida),</i> Eastern white pine <i>(Pinus strobus),</i> Virginia pine <i>(Pinus virginiana)</i>	200 🦋	
Shrubs	Vaccinium	Northem highbush blueberry (Vaccinium corymbosum), Black highbush blueberry (Vaccinium fuscatum), Hillside blueberry (Vaccinium pallidum)	217 💓	14 🙀
	Salix	Prairie willow (Salix humilis), Black willow (Salix nigra)	289 😽	14 🙀
Flowering Perennials	Solidago	Stiff leaf goldenrod (Solidago rigida), Atlantic goldenrod (Solidago arguta)	104 🦋	92 🍎
	Symphyotrichum	Blue wood aster (Symphyotrichum cordifolium), Smooth aster (Symphyotrichum Iaeve)	100 🦋	33 🙀
	Helianthus	Woodland sunflower (Helianthus divaricatus), Small woodland sunflower (Helianthus microcephalus)	66 W	50 🙀

Rudbeckia	Black-eyed Susan (Rudbeckia hirta), Green-headed coneflower (Rudbeckia laciniata)	20 💓	29
Heterotheca	Camphorweed (Heterotheca subaxillaris)		24
Grindelia	Curlycup gumweed (Grindelia squarrosa)		31
Chrysopsis	Maryland golden-aster (Chrysopsis mariana)	5 🔰	20
Coreopsis	Lanceleaf coreopsis (Careopsis lanceolata), Large flower coreopsis (Coreopsis grandiflora)	7 ₩	22
Bidens	Devils's beggartick (Bidens frondosa), Small beggartick (Bidens discoidea)		15 🙀
Verbesina	Wingstem (Verbesina alternifolia)	20 💓	17 🎬
	Rudbeckia Heterotheca Grindella Chrysopsis Coreopsis Bidens Verbesina	Rudbeckia Black-eyed Susan (Rudbeckia hirta), Green-headed coneflower (Rudbeckia laciniata) Heterotheca Camphorweed (Heterotheca subaxillaris) Grindelia Curlycup gurnweed (Grindelia squarrosa) Chrysopsis Maryland golden-aster (Chrysopsis mariana) Coreopsis Lanceleaf coreopsis (Coreopsis stanceolata), Large flower coreopsis (Coreopsis grandifiora) Bidens Devils's beggartick (Bidens frondosa), Small beggartick (Bidens discoidea) Verbesina Wingstem (Verbesina alternifalia)	Rudbeckia Black-eyed Susan (Rudbeckia hirta), Green-headed coneflower (Rudbeckia laciniata) 20 Heterotheca Camphorweed (Heterotheca subaxillaris) 1 Grindelia Curtycup gumweed (Grindelia squarrosa) 1 Chrysopsis Maryland golden-aster (Chrysopsis mariana) 5 Coreopsis Lanceleaf coreopsis (Coreopsis lancedata), Large flower coreopsis (Coreopsis grandiflora) 7 Bidens Devils's beggartick (Bidens frondosa), Small beggartick (Bidens discoidea) 20 Verbesina Wingstem (Verbesina alternifalia) 20

Top 30 Keystone Plant Genera for Butterfly and Moth Caterpillar

Top 30 Native Host Plants for Pollen Specialist Bees

Genus	Common Plant Name	# of Caterpillar Species that use this as a Host Plant	
Quercus	oak	436	
Prunus	almand, apricot, cherry, peach, plum	340	
Salix	willow	289	
Betula	birch	289	
Populus	aspen, cottonwood, poplar	249	
Acer	maple	238	
Malus	apple	237	
Vaccinium	blueberry, cranberry, deerberry	217	
Carya	hickory	213	
Pinus	pine	200	
Alnus	alder	173	
Ulmus	elm	164	
Picea	spruce	132	
Tillia	basawood	132	
Crataegus	hawthorn	131	
Rubus	blackberry, raspberry	127	
Juglans	walnut	125	
Fraxinus	ash	121	
Fagus	beech	116	
Castanea	chestnut	115	
Abies	fir	112	
Larix	larch	110	
Corylus	hazel	108	
Solidago	goldenrod	104	
Myrica	bayberry	103	
Rosa	rose	102	
Symphyotrichum	aster	100	
Cornus	dogwood	98	
Tsuga	hemlock	92	
Amelanchier	serviceberry	92	

Genus	Common Plant Name	# of Pollen Specialist Bee Species Relying on this Plant
Helianthus	sunflower	50
Solidago	goldenrod	92
Symphyotrichum	aster	33
Grindelia	gumweed	31
Rudbeckia	black eyed susan	29
Heterotheca	goldenaster	24
Coreopsis	tickseed	22
Chrysopsis	goldenaster	20
Verbesina	wingstem	17
Bidens	beggartick	15
Cirsium	thistle	15
Salix	willow	19
Vaccinium	blueberry, cranberry, deerberry	19
Erigeron	fleabane	12
Vernonia	ironweed	12
Pityopsis	silkgrass	11
Ratibida	prairie coneflower	11
Silphium	rosinweed	10
Baccharis	baccharis	8
Euthamia	goldentop	8
Dalea	prairie clover	7
Oenothera	evening primrose	7
Echinacea	coneflower	6
Gaillardia	blanketflower	6
Balduina	honeycombhead	5
Helenium	sneezeweed	5
Heliopsis	heliopsis	5
Pectis	chinchweed	5
Cornus	dogwood	4
Lvonia	staggerbush	4

Southeastern Blueberry Bee

Squash Bee

Hibiscus Bee

Sweet Potato Vine Bee

Sunflower Bee



Common Milkweed Asclepias syriaca Swamp, Marsh, Red Milkweed

Asclepias incarnata







Disturbance Forget Tidy



Nest Sites and Sleeping Areas





Cut stems 18" to 24" for Nest Sites



Disturbance - Leave the Leaves

Biodiversity Guides and Handbooks | AMNH



Dispersal and Connectivity

CONNECTIVITY **IS THE SAFETY NET OF NATURE**

What is connectivity?

Connectivity is the degree to which movement and natural ecological processes.



landscapes and seascapes allow species



What does connectivity do?

Allows species to migrate or disperse to feed, breed, and respond to climate change. Allows natural communities to thrive by maintaining ecosystem functions like pollination and stream flows.

What do we want?

Connected lands and waters: wildlife corridors, landscape linkage areas, free flowing and connected rivers, interconnected coastal and marine zones, and climate-resilient ecosystems.





Why should you care?

Connected lands and waters benefit nature and people. As the climate changes and development increases, we must act now to save and restore natural connections across all lands and waters.

Guiding principles for rewilding



Carver S, Convery I, Hawkins S, Beyers R, Eagle A, Kun Z, Van Maanen E, Cao Y, Fisher M, Edwards SR, Nelson C, Gann GD, Shurter S, Aguilar K, Andrade A, Ripple WJ, Davis J, Sinclair A, Bekoff M, Noss R, Foreman D, Pettersson H, Root-Bernstein M, Svenning JC, Taylor P, Wynne-Jones S, Featherstone AW, Fløjgaard C, Stanley-Price M, Navarro LM, Aykroyd T, Parfitt A, Soulé M. Guiding principles for rewilding. Conserv Biol. 2021 Dec;35(6):1882-1893. doi: 10.1111/cobi.13730. Epub 2021 Jun 4. Erratum in: Conserv Biol. 2023 Dec;37(6):e14017. PMID: 33728690.

Corridors and Community



Foraging Distance of Bees Related to Size



Distances these bees will forage for pollen/nectar



Bee Body Size



Colletes inaequalis Max flight limit: 0.5 mi





Osmia inspergens Max flight limit: 0.25 mi



1

Halictus ligatus Max flight limit: 560 ft



Lasioglossum leucomomum Max flight limit: 90 ft



Photos @ Laurence Packer 2014 via Discover Life

https://umaine.edu/beemapper/landscape-ecology-wild-bees/

https://www.houstonnativebees.org/beeline/

How you can reconnect habitats



How you can reconnect habitats











BUFFERING (Patch)









Monarch Highway



Butterflyweed Asclepias tuberosa







Educate Your Neighbors – Intentionality and Acceptance



These native plants provide food sources for beneficial insects and support songbirds and other cherished wildlife.

For native plant resources for the lower Midwest, visit www.grownative.org.



These native plants provide food sources for beneficial insects and support songbirds and other cherished wildlife.

SREW

For native plant resources for the lower Midwest, visit www.grownative.org



Educate Your Neighbors – Intentionality and Acceptance Raised Beds and Fencing



Educate Your Neighbors – Intentionality and Acceptance





Coexistence Educate Yourself



Silent Earth

DAVE GOULSON



Rewild Your Thoughts

Rewilding is also about the way we think. It is about understanding that we are one species among many, bound together in an intricate web of life that ties us to the atmosphere, the weather, the tide, the soils, the freshwater, the oceans, and all living creatures on the planet.

re:wild (rewild.org)

"When we try to pick out anything by itself, we find it hitched to everything else in the universe." John Muir

The old Lakota was wise. He knew that man's heart away from nature becomes hard: he knew that lack of respect for growing, living things soon led to lack of respect for humans too.

Mathó Nážin (Standing Bear), Sicangu/Oglala Lakota



"The last word in ignorance is the man who says of an animal or plant, "What good is it?" If the land mechanism as a whole is good, then every part is good, whether we understand it or not. If the biota, in the course of aeons, has built something we like but do not understand, then who but a fool would discard seemingly useless parts? To keep every cog and wheel is the first precaution of intelligent tinkering."

—Aldo Leopold, Round River: From the Journals of Aldo Leopold

Grow Native



https://grownative.org/

The Xerces Society

Pollinator Conservation Resource Center

Region-specific Information from Extension, NRCS, NGO, and other sources, including:

- Plant Lists
- Conservation Guides
- Pesticide Guidelines

www.xerces.org/pollinatorresource-center



The Xerces Society + 4828 SE Hawthorne Blvd. Portland, Oregon 97215 USA + tel 503.232.6639 + fax 503.233.6794 + info@xerces.org site map + contact + give + contact the webmaster

Pollinator Partnership



https://www.pollinator.org/guides

"If you have a backyard, this book is for you." -Richard Louv, author of Last Child in the Woods

Bringing Nature Home

UPDATED AND EXPANDED

How You Can Sustain Wildlife with Native Plants

Douglas W. Tallamy Foreword by Rick Darke



A New Approach to Conservation That Starts in Your Yard

DOUGLAS W. TALLAMY







Insect Pollinator Identification

KAUFMAN Field Guide to Insects of North America

The easiest guides for fast identification

> "The first truly thorough treatment of the North American insects in field guide form." JOHN ACORN, entomologist,

author, and broadcaster

ERIC R. EATON

& KENN KAUFMAN

ROBBER FLIES

288 TRUE FLIES

(family Asilidae) are to other insects what falcons are to other birds: swift predators on the wing. They vary greatly in size (3-50 mm long) and shape (long and slender to compact and robust). They are most diverse in the western and central U.S. All can be recognized by the usually "bearded" face and the concave top of the head between their eyes. Many act like flycatchers, perching on logs, foliage, twigs, or the ground, cocking their heads at insects passing overhead, and dashing out to apprehend a victim. In the few cases in which their life histories are known. robber fly larvae are external parasites of beetle grubs or larvae of other insects. There are close to 1,000 species in North America.

The genus Laphria includes remarkable bumble bee mimics. There are at least 63 species on the continent. Look for them in forests where the canopy opens or there is dappled sunlight. The eastern Laphria grossa often alights on stumps of oak and elm. It is known to feed on Japanese beetles. The smaller Laphria thoracica is quite common in the northeast U.S. It sometimes stakes out apiaries and feeds on the honey bees. The color pattern varies greatly among individuals. Laphria saffrana probably mimics queens of the Southern Yellowjacket (p. 356). Look for it in pine forests and coastal plains of the southeast. Laphria astur ranges in the northwest. Laphria index is probably a complex of several species, transcontinental in Canada and the northern U.S., marked with metallic copper or orange on the thorax and abdomen. Laphria canis probably represents another species complex occurring mostly in the east.

Efferia is an enormous genus with 100 species in North America, many of them very common, especially in the west. Watch for them in dry, open habitats such as fields, thickets, and forest edges, where they land on posts and other exposed perches. Males have conspicuous bulbous claspers on the tip of the abdomen and are marked with dazzling silver bands. Females use their swordlike ovipositor to deposit eggs in dead flower heads, cracks in the soil, and other crevices.

Promachus is a widespread genus in North America, with 21 species here, including Promachus hinei of the central states. You might hear this species before you see it, as it departs its perch with a loud, buzzing flight, quickly alighting again nearby, usually on a vertical branch or twig.

Members of the genus Mallophorina are recognized by their bright green eyes. The 15 species in North America prey almost exclusively on bees and wasps. Mallophora includes 14 species in North America, bee mimics that prey mostly on honey bees, bumble bees, and wasps,

The genus Proctacanthus includes 18 North American species. They are large flies, capable of taking prey the size of grasshoppers. They are seen mostly in grasslands and on shrubs along the margins of woods and swamps, but a few species hang out on riverbanks.

Asilus is a large genus, with 74 species in North America. Asilus sericeus ranges over much of the eastern U.S. This is one of the first robber flies of spring in the southern part of its range, but adults are on the wing through August. Look for them resting on twigs, weeds, or open ground.



Laphria Laphria sattrana thoracica Laphria astur Laphria female canis Efferia sp. Laphria index Mallophorina sp. Mallophora sp. Asilus sp 289

Laphria grossa

ROBBER FLIES

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An Identification Guide

Bumble Bees

Paul Williams, Robbin Thorp, Leif Richardson & Sheila Colla

Includes Tree, Shrub, and Perennial Plant Profiles for the Midwest, Great Lakes, and Northeast Regions

BEES

An Identification and Native Plant Forage Guide HEATHER HOLM Author of Polliperons of Nervy Plants

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OF NATIVE PLANTS

Attract, Observe and Identify Pollinators and Beneficial Insects with Native Plants



Heather Holm

A Guide to North America's Bees

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'A wonderful book, visionary, illuminating and fascinating." GEORGE MONBIOT











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"A musterial for these concerned about biodiversity loss." - Jane Evodult M | L L | E | K E R R

Telegraph





Rewilding Podcasts







"We need acts of restoration, not only for polluted waters and degraded lands, but also for our relationship to the world. We need to restore honor to the way we live, so that when we walk through the world we don't have to avert our eyes with shame, so that we can hold our heads up high and receive the respectful acknowledgment of the rest of the earth's beings." - Robin Wall Kimmerer

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