Nov 20, 2020 Pesticide recertification
Pollinators and endangered species
UM CFANS CUES website cues.cfans.umn.edu

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Why Conserve Pollinators?

1. More than 67% of flowering plants need pollinators (240,000 species).

2. Ecosystem services:
pollination produces fruits and seeds.

3. Fruits fed on by birds, such as crabapple, cherry, chokecherry, mountain ash, apple, blueberry, sunflower, all need pollinators.

4. 35% of crops, $18.9 billion in U.S. ($217 billion worldwide) require pollinators.

5. 1/3 of the food we eat needs pollinators.

Native Bees also in Decline

leafcutter: *Megachile*

Bumble bee: *Bombus*

Economic value of native pollinators?

1. **Hundreds of species of native bee contribute significantly to crop pollination.**
2. **$3 billion/year**

Sweat bee: Halictidae

Digger bee: *Andrena*

Mason bee: *Osmia*

Krischik lab websites

IPM resources for greenhouses and ornamentals
http://cues.cfans.umn.edu/

Pollinator Conservation
https://ncipmhort.cfans.umn.edu/

MNLA online course fro certification training for MDA pesticide license
https://pesticidecert.cfans.umn.edu/

Save the bees by planting flowers and trees

1. Use contact insecticides on flowering plants, such as bifenthrin, cyfluthrin, Bt, soaps, insect growth regulators
2. Do not use systemic insecticides.
3. Plant a seasonal phenology of native and garden plants for nectar and pollen.
4. Only single-flowered plants, not double flowers, provide pollen and nectar.
5. Provide overwintering habitat for bees.
6. Do not kill queen bees in the spring/fall, they will not sting.
7. Understand the different types of bees and wasps so you can conserve bees.

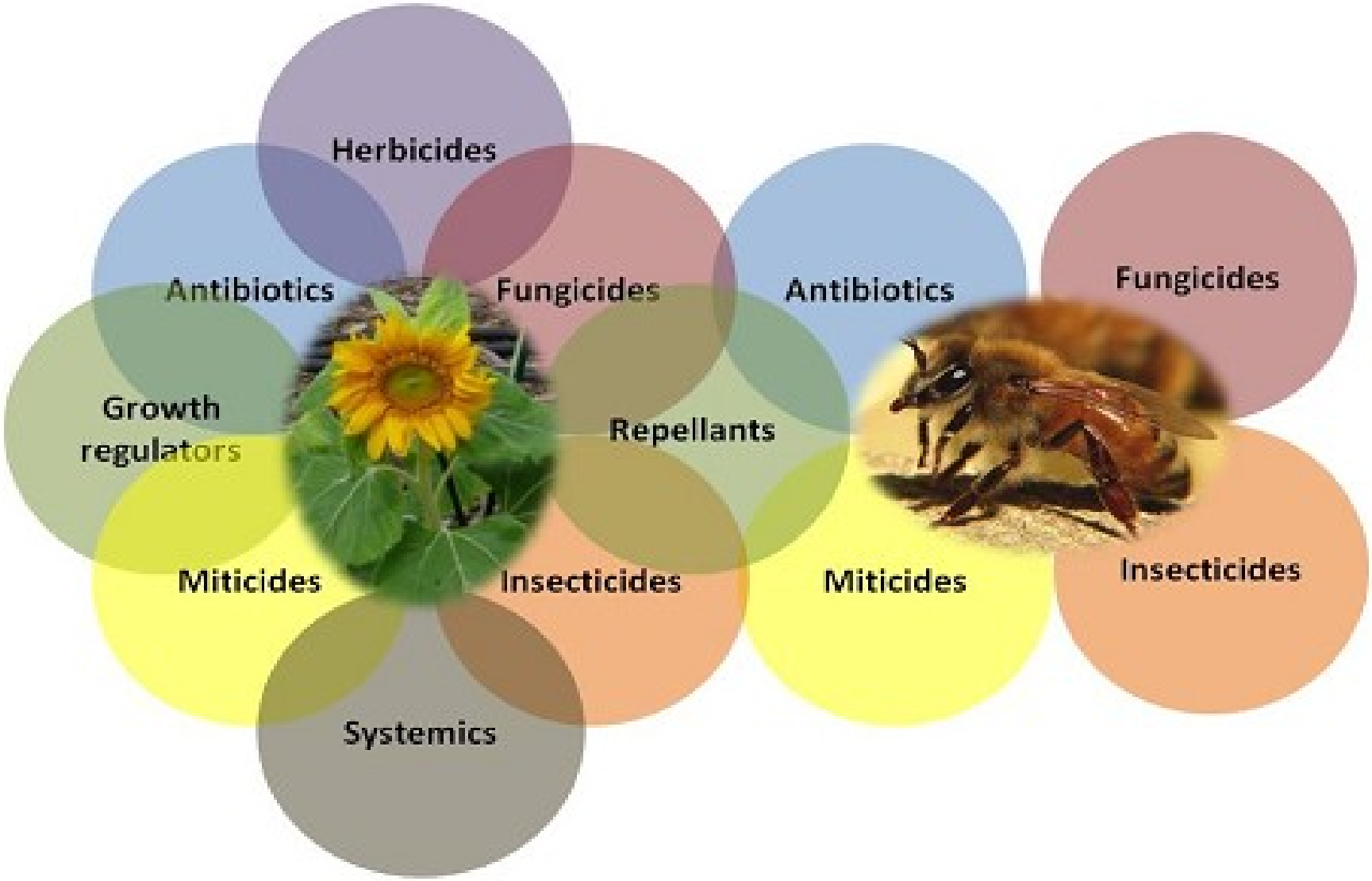
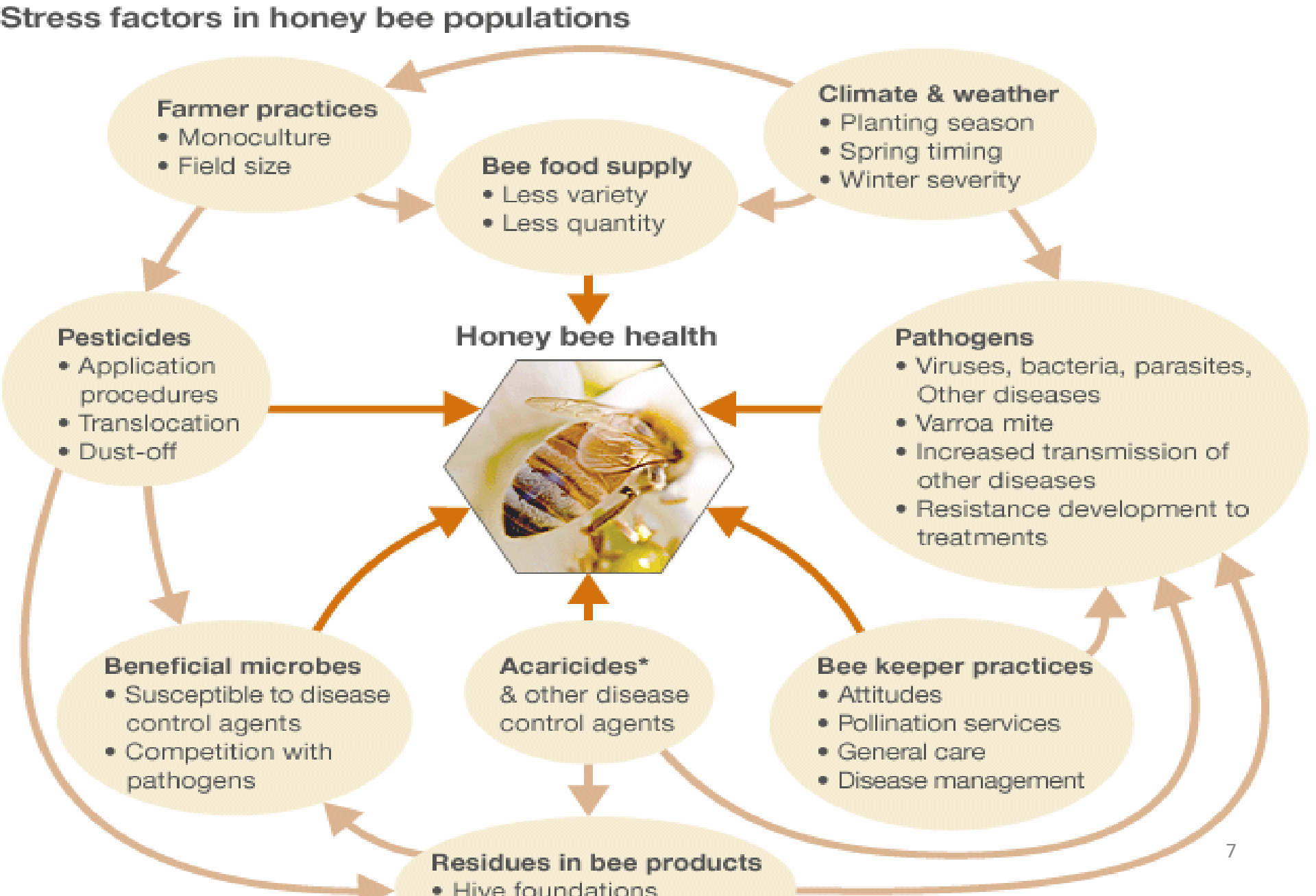


photo from Ohio State University

http://www.entomology.umn.edu/cues/pollinators/index.html

Many stresses contribute to CCD in honeybees

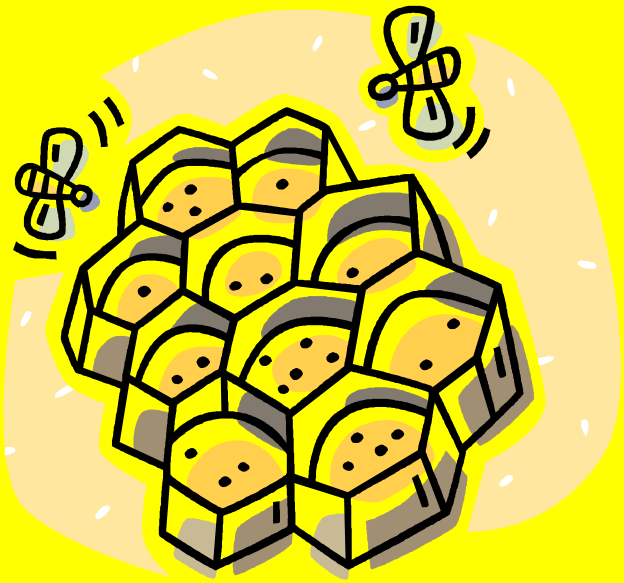


What makes a species endangered?




	Gypsy moth ***Lymantria dispar*** **exotic**	**Painted lady butterfly** ***Vanessa cardui*** **native**	**Karner blue butterfly** ***Lycaeides melissa samuelis*** **native**
status	Widespread	Widespread	Endangered
No hosts for larval feeding	300+ species	100+ species	1 species *Lupinus perennis*
habitat	Trees	Lawns, fields	Sand dunes
generations	1	6	2
No eggs	1,000	700	50
overwinter	Eggs on trees	Migrate to South	Eggs on lupines

What are bees?



- Most bees are solitary; honey bees, bumble bees, and some sweat bees are social.
- Among the social bees, only honey bee colonies are perennial (survive year to year).
- Solitary and social wasps are sometimes mistaken for bees. Social wasps have annual colonies like bumble bees.

Red-tailed bumble bee (*Bombus ternarius*)
Rob Routledge, Sault College, Bugwood.org

Common eastern bumble bee (*B. impatiens*)
David Cappaert, Michigan State University, Bugwood.org

Bumble Bees, *Bombus* spp., Order Hymenoptera Family Apidae

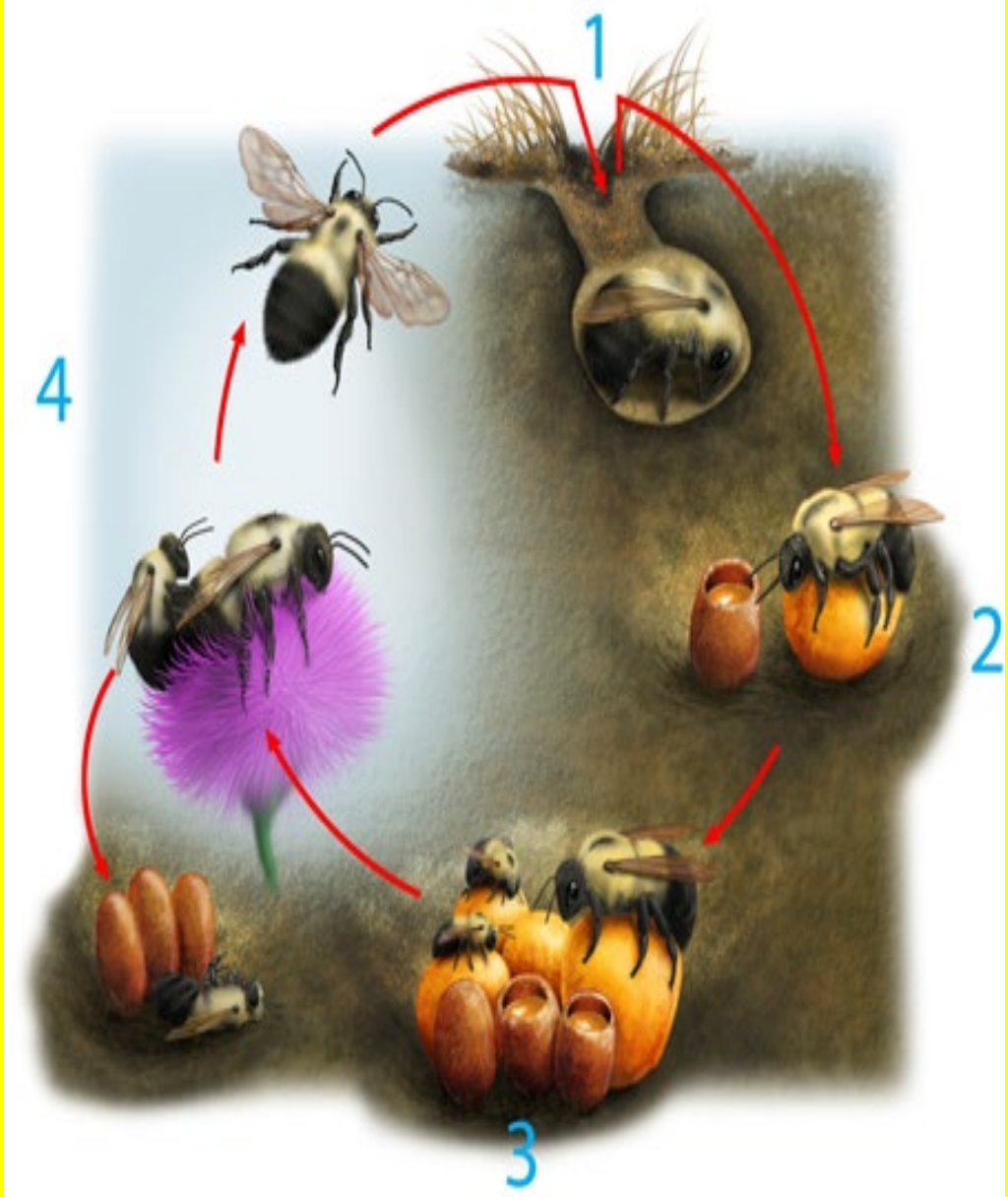
These large (10 to 23 mm), hairy bees are the only truly social bees native to the United States.

Colonies are annual.

Fecundated queens emerge in spring and begin colonies in the ground.

Queens mate with unrelated males before overwintering in the ground.

Bumble bee colony life cycle



1. A queen emerges from hibernation in spring and finds a nest site, such as an abandoned rodent burrow.

2. She creates wax pots to hold nectar and pollen, on which she lays and incubates her eggs.

3 In autumn the colony produces new queens and male bees.

4. Newly mated queens hibernate and the rest of the bees die.

Honey Bee Colony

Inside a honey bee colony. Note capped brood cells containing pupae and open brood cells with larvae (unlike bumble bees, who cap cells immediately after laying eggs).

Bumble Bee Colony

Inside a commercial bumble bee colony. Note capped brood cells, shiny “honey pots” full of nectar, and size difference between workers and two large queens (one is newly produced).

Outline: Endangered species

- **Why are some species endangered and others florish?**

  Habitat loss and pesticide use contribute
- **Rusty-patched bumblebee**
- **Changing the paradigm; bee lawns; reduce herbicide use + cosmetic use; reducing glyphosate; neonics birds**
- **IPM, BMP, OMRI, oh my**
- **What you can do.**

What makes a species endangered?

- How many species are endangered?
- 7,000 species
- Over 7,000 species around the world are considered endangered. That number doesn't even include the plants, animals, and other life-forms that are listed by some scientists as vulnerable, critically endangered, or extinct in the wild—all rankings that mean a species is inching closer and closer to ill-fated extinction.

What makes a species endangered?

- **Convention on Biological Diversity**
  The Convention on Biological Diversity is an international treaty to sustain and protect the diversity of life on Earth. This includes conservation, sustainability, and sharing the benefits of genetic research and resources. The Convention on Biological Diversity has adopted the IUCN Red List of endangered species in order to monitor and research species' population and habitats.

  Three nations have not ratified the Convention on Biological Diversity: Andorra, the Holy City (Vatican), and the United States.

What makes a species endangered?

- **Species become endangered for two main reasons: loss of habitat and loss of genetic variation. A loss of habitat can happen naturally. ... Human activity can also contribute to a loss of habitat. Development for housing, industry, and agriculture reduces the habitat of native organisms.**
- **Endangered insects Midwest: 8 species**
- **Endangered insects US: 35 species**

What makes a species endangered?

- **Endangered, Threatened, Proposed, and Candidates in the Upper Midwest**

American burying beetle (*Nicrophorus americanus*)

Status: Endangered

Dakota skipper (*Hesperia dacotae*)

Status: Threatened

Hine's emerald dragonfly (*Somatochlora hineana*)

Status: Endangered

Hungerford's crawling water beetle *(Brychius hungerfordi*)

Status: Endangered, listed March 7, 1994

Karner blue butterfly (*Lycaeides melissa samuelis*), **lupines on sandy soil**

Status: Endangered

Mitchell's satyr butterfly (*Neonympha mitchellii mitchellii*)

Status: Endangered

Poweshiek Skipperling (*Oarisma poweshiek*), **remnant prairie**

Status: Endangered

Rusty Patched Bumble Bee (*Bombus affinis*), **urban areas, farm lands**

Status: Proposed as Endangered

What makes a species endangered?

- The categories of concerned species are: least concerned and near-threatened.
- The four categories of endangered species are vulnerable, endangered, critically endangered, and extinct in the wild.
- There are five major causes of extinction: habitat loss, an introduced species, pollution, population growth, and overconsumption.

What makes a species endangered?

- **The International Union for Conservation of Nature (IUCN) keeps a "Red List of Threatened Species." The Red List defines the severity and specific causes of a species' threat of extinction.**
- **The Red List has seven levels of conservation: least concern, near threatened, vulnerable, endangered, critically endangered, extinct in the wild, and extinct.**

What makes a species endangered?

- **The definitions of the three threatened categories (vulnerable, endangered, and critically endangered) are based on five criteria: population reduction rate, geographic range, population size, population restrictions, and probability of extinction.**

What makes a species endangered?

- ***1) Population reduction rate***

A species is classified as endangered when its population has declined between 50 and 70 percent. This decline is measured over 10 years or three generations of the species, whichever is longer.

What makes a species endangered?

- ***2) Geographic range***

An endangered species' extent of occurrence is less than 5,000 square kilometers (1,930 square miles). An endangered species' area of occupancy is less than 500 square kilometers (193 square miles).

What makes a species endangered?

- ***3) Population size***

A species is classified as endangered when there are fewer than 2,500 mature individuals. When a species population declines by at least 20 percent within five years or two generations, it is also classified as endangered.

What makes a species endangered?

- Can an endangered species have its status improved? Yes
- The brown pelican is native to the coasts of North America and South America, as well as the islands of the Caribbean Sea. It is the state bird of the U.S. state of Louisiana. In 1970, the number of brown pelicans in the wild was estimated at 10,000. The bird was classified as vulnerable. It was listed as endangered.

- During the 1970s and 1980s, governments and conservation groups worked to help the brown pelican recover. Young chicks were reared in hatching sites, then released into the wild. Human access to nesting sites was severely restricted. The pesticide DDT, which damaged the eggs of the brown pelican, was banned. During the 1980s, the number of brown pelicans soared. In 1988, the IUCN "delisted" the brown pelican. The bird, whose population is now in the hundreds of thousands, is now in the category of least concern.

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- What you can do.

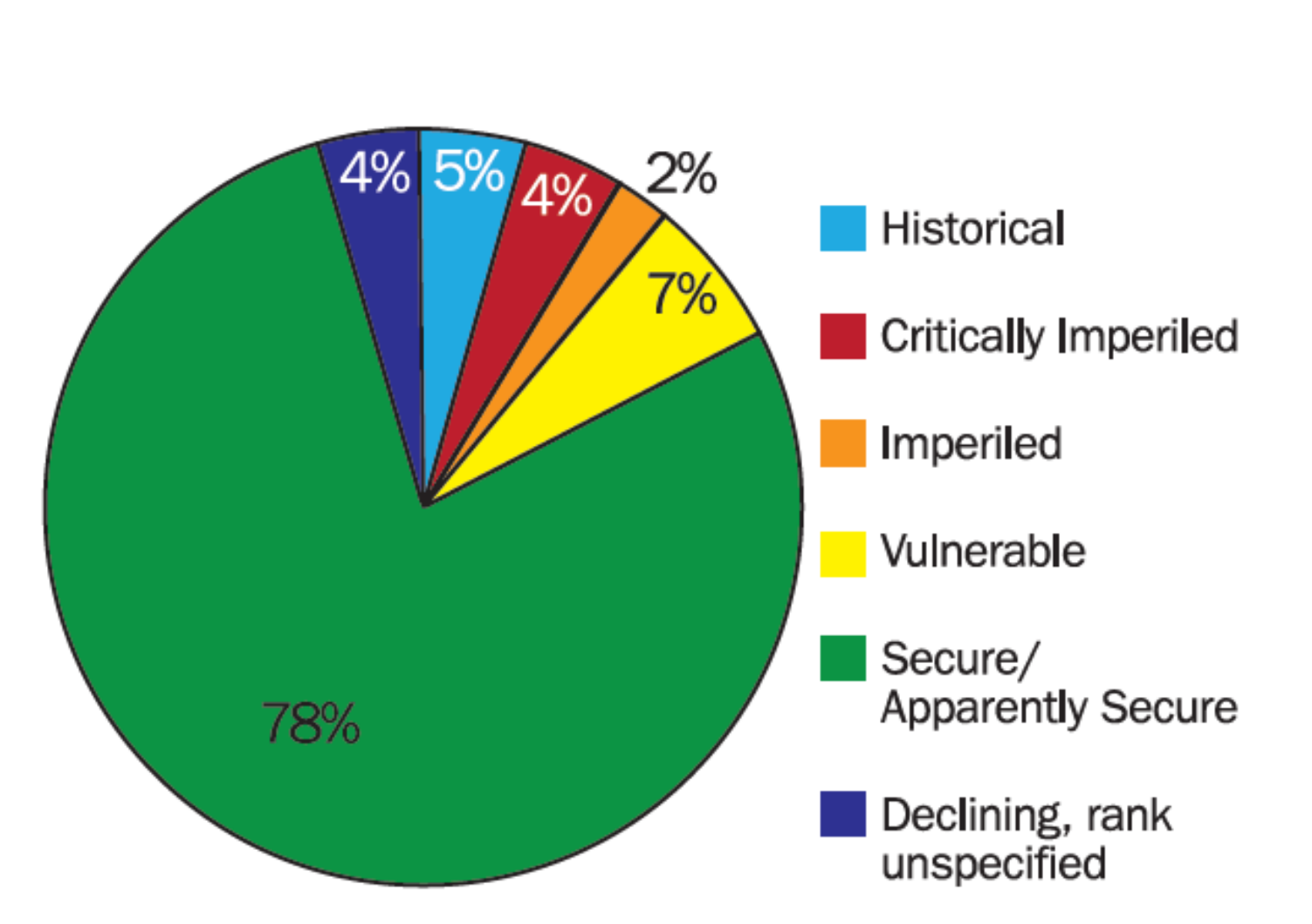
What makes a species endangered?
bumblebee *Bombus*

- **Bumblebees are annual species. The spring to late summer period of colony founding, build up, and production of reproductive individuals, followed by the overwintering of new queens provide the natural history basis for management considerations of the approximately 46 North American species.**

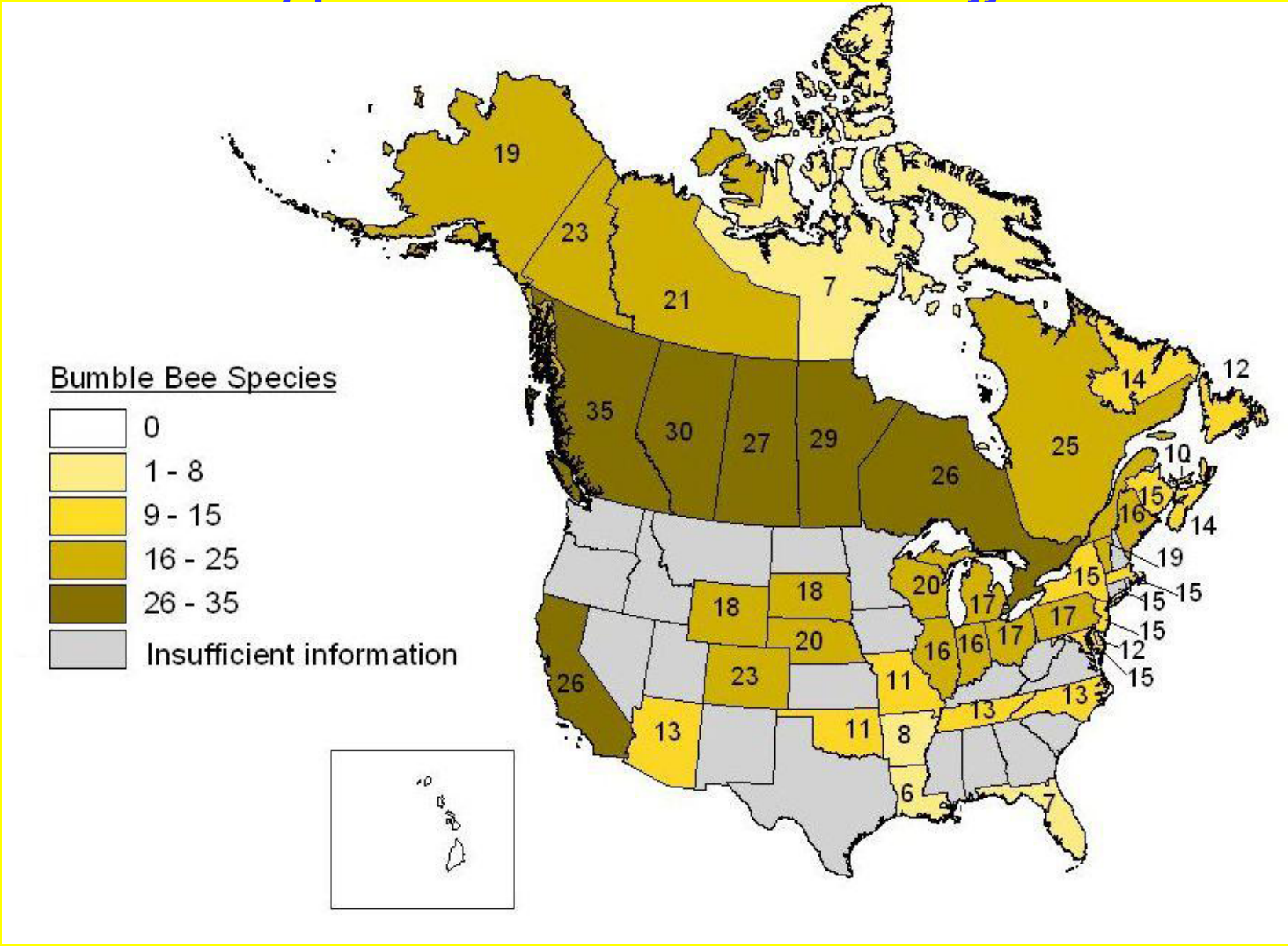
- **Eight species from three subgenera, however, have declined drastically during the last 15-20 years. These include three species that are obligate parasites on other declining species. The pathogen spillover hypothesis, which proposes that diseases from infected commercial colonies are releasing pathogens in the field**

- **Other threats to bumble bees include climate change, loss of nesting and foraging habitats and pesticide use.**

What makes a species endangered?
Proportion NA BB at risk



What makes a species endangered?
Rusty patched bumblebee *Bombus affinis*



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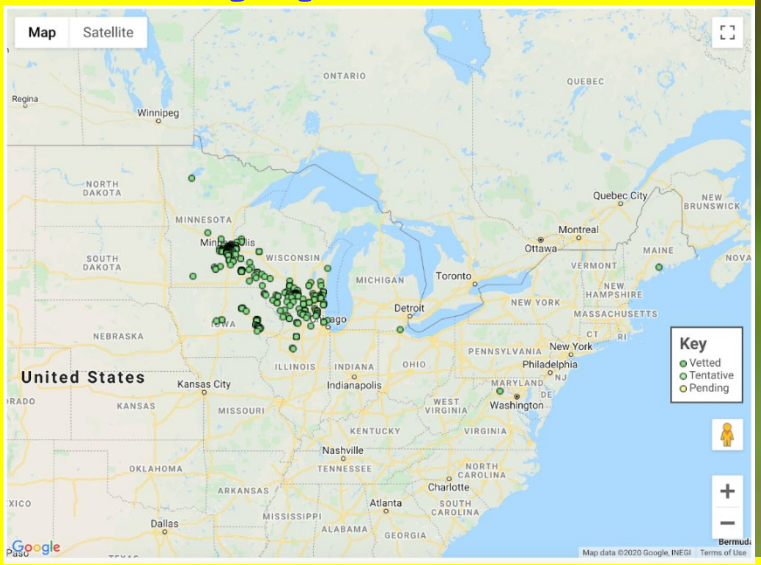
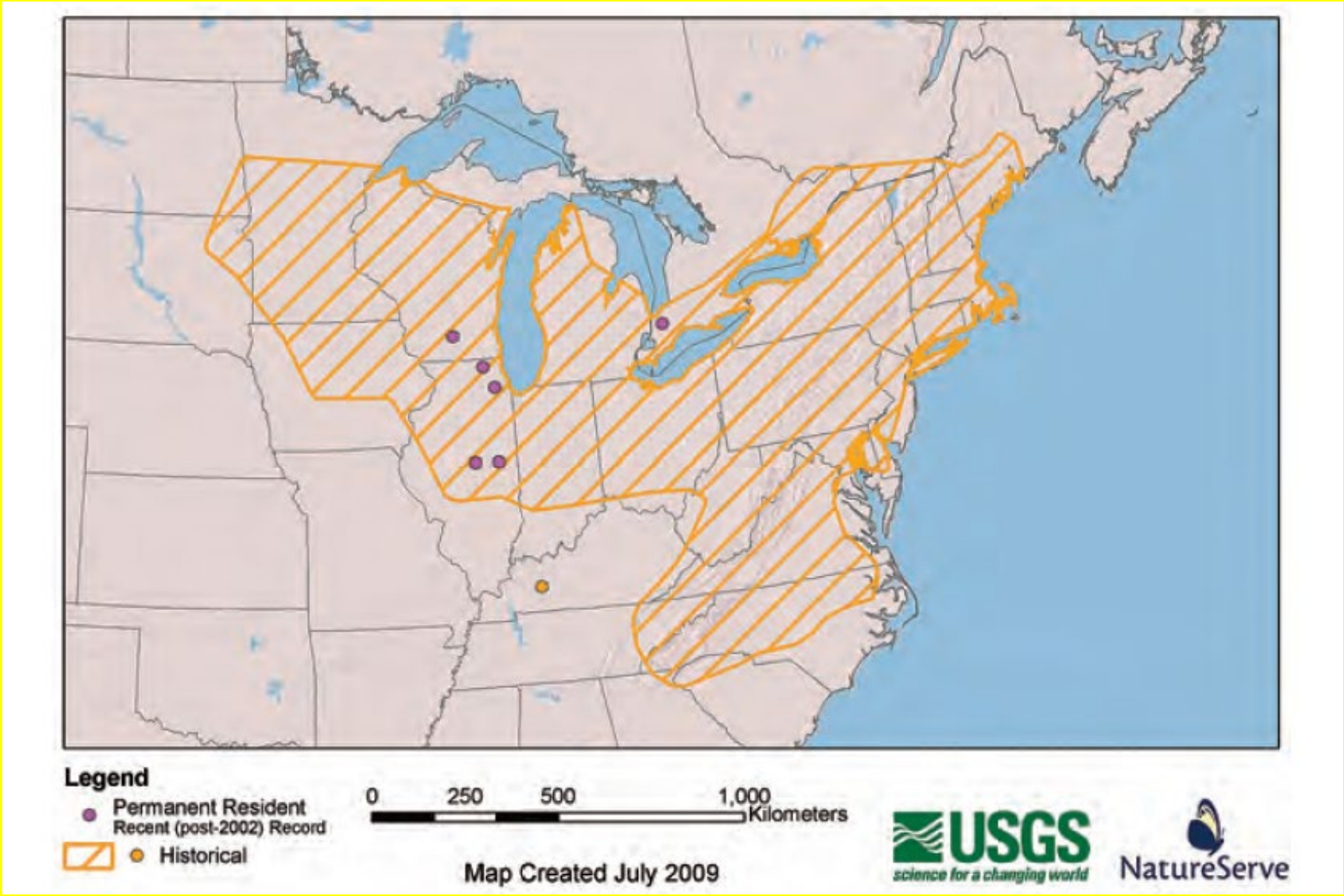


Rusty Patched Bumble Bee (Bombus affinis)
Status: Endangered
Current Range: IL, IN, IA, ME, MA, MN, OH, VA, WV, WI and Ontario, Canada
The rusty patched bumble bee has declined by 87 percent in the last 20 years. The species is likely to be present in only 0.1% of its historical range. There are many potential reasons for the rusty patched bumble bee decline including habitat loss, intensive farming, disease, pesticide use and climate change. With the odds seemingly stacked against the rusty patched bumble bee, there is a role for everyone in conserving this beneficial pollinator. Your actions will also help a host of bees, butterflies and birds that share resources with the rusty patched bumble bee.

What makes a species endangered?

Rusty patched bumblebee *Bombus affinis*



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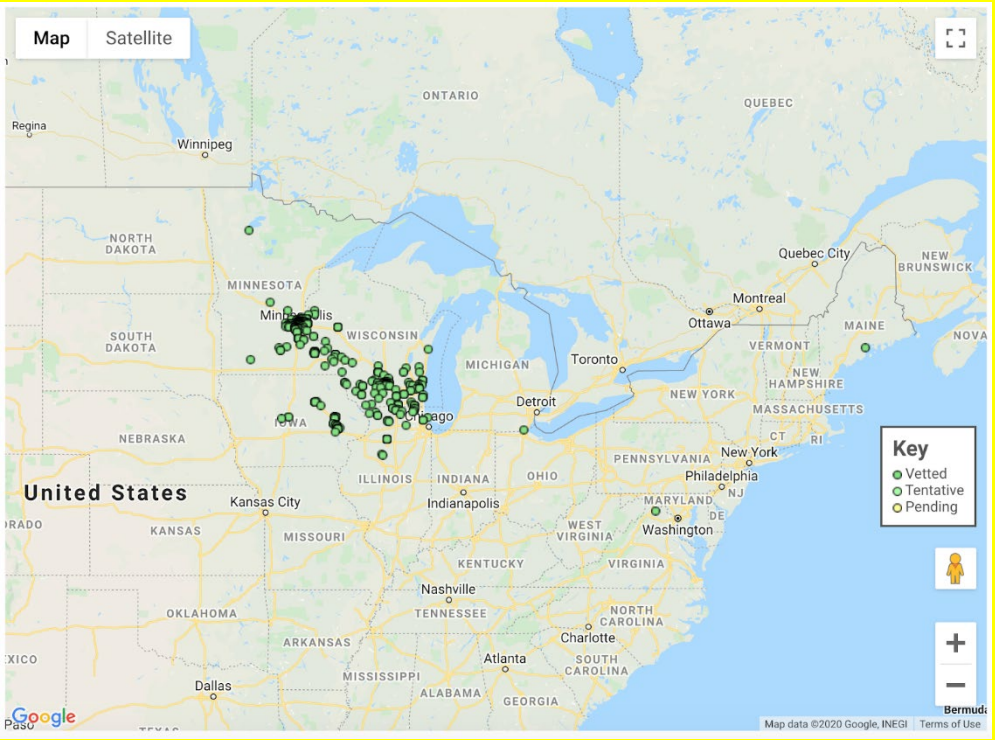

2020 Minnesota's official state bee made a rare city appearance. Rusty patched bumble bees were discovered in prairie flower plantings by Bloomington Civic Plaza, 1800 West Old Shakopee Road. U.S. Fish and Wildlife Service Urban Biologist Nicole Menard found five rusty patched bumble bees foraging on wild bergamot, a Minnesota native plant known to attract pollinators. This discovery shows how prairie restorations, such as the ones the City has completed in recent years, can attract a wide variety of beneficial insects.

What makes a species endangered?
Rusty patched bumblebee *Bombus affinis*

worker **queen**

The rusty patched bumble bee is a relatively large, black and yellow bumble bee. Queens are 20–22 mm (0.79–0.87 in.) in length with no orange band. Workers have orange bands and are smaller, reaching 13–17.5 mm (0.52–0.69 in.) in length. Male drones have orange bands and are slightly bigger than the female workers.

IPM: Cultural methods to modify the habitat to help bumblebees BB

- Bumblebees nest in rodent dens underground and above ground.
- Do not remove downed trees, brush piles, dead trees, and winter grasses.
- Coexist with BB colonies as they are passive and do not sting and chase people like wasps.
- Retrofit landscapes to include season long pollinator plants
- Do not use toxic conventional or organic insecticides; switch to biorational insecticides
- Stop using herbicides as they have been shown to decrease BB colonies.
- Use on spot treatments of fungicides as they have been shown to decrease BB colonies.
- Plant bee lawns and only use biorational insecticides, fungicides, and herbicides.

IPM: If rusty-patched BB is detected, you must develop a management plan with MDA and MNDNR

- **Must develop management plans compatible with conserving BB**
- **Limit pesticide use and habitat destruction.**

DEPARTMENT OF AGRICULTURE

DEPARTMENT OF NATURAL RESOURCES

Develop a management plan with MDA and MNDNR

Minnesota's endangered species law

- Minnesota's Endangered Species Statute (link is external) requires the Minnesota Department of Natural Resources (DNR) to adopt rules designating species meeting the statutory definitions of endangered, threatened, or species of special concern. The resulting List of Endangered, Threatened, and Special Concern Species is codified as Minnesota Rules, Chapter 6134 (link is external) . The Endangered Species Statute also authorizes the DNR to adopt rules that regulate treatment of species designated as endangered and threatened. These regulations are codified as Minnesota Rules, Parts 6212.1800 to 6212.2300 (link is external) .

- Minnesota's Endangered Species Statute and the associated Rules impose a variety of restrictions, a permit program, and several exemptions pertaining to species designated as endangered or threatened. A person may not take, import, transport, or sell any portion of an endangered or threatened species. However, these acts may be allowed by permit issued by the DNR; plants on certain agricultural lands and plants destroyed in consequence of certain agricultural practices are exempt; and the accidental, unknowing destruction of designated plants is exempt. Species of special concern are not protected by Minnesota's Endangered Species Statute or the associated Rules. Persons are advised to read the full text of the Statute and Rules in order to understand all regulations pertaining to species that are designated as endangered, threatened, or species of special concern.

- Note that the federal Endangered Species Act of 1973 (link is external) , as amended (16 USC 1531 - 1544) requires the U.S. Department of the Interior to identify species as endangered or threatened according to a separate set of definitions, and imposes a separate set of restrictions pertaining to those species. Search here to see the federal status of species.https://www.dnr.state.mn.us/rsg/laws.html

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Conservation organizations for bees

- **Bumblebee watchhttps://www.bumblebeewatch.org/**
- **A collaborative effort to track and conserve North America's bumble bees.**
- **Helps researchers determine the status and conservation needs of bumble bees**
- **Helps locate rare or endangered populations of bumble bees**
- **Learn about bumble bees, their ecology, and ongoing conservation efforts**
- **Connect with other community scientists**

Outline: Endangered species

- Why are some species endangered and others florish?

Habitat loss and pesticide use contribute

- Rusty-patched bumblebee
- IPM, BMP, OMRI changing the paradigm; bee lawns; reduce herbicide use + cosmetic use; reducing glyphosate
- What you can do.

What is IPM?

KEEP THE BUZZ IN LEIGHTON BUZZARD

Bee Champion

I am letting my lawn grow so the flowers in it help the bees

Bee Friendly Lawn

Bee unfriendly lawn

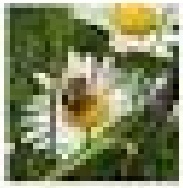
Flowers that are in the lawn provide vital food for bees and long grass is important for Bumble Bee nests and is crucial for butterflies.

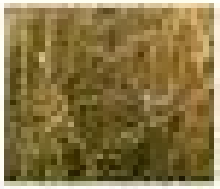
We have lost half our bees in the last 20 years due to toxic chemicals and pesticides.

We have lost 97% of our flowery meadows since 1930, so giving the bees the flowers in my lawn really helps.

Bumble bees and solitary bees are even important for pollination than honey bees especially for tomatoes, strawberries and apples.

Last year British farmers had to import 50,000 colonies (that's 5 million bees) in order to pollinate soft fruits and tomatoes.

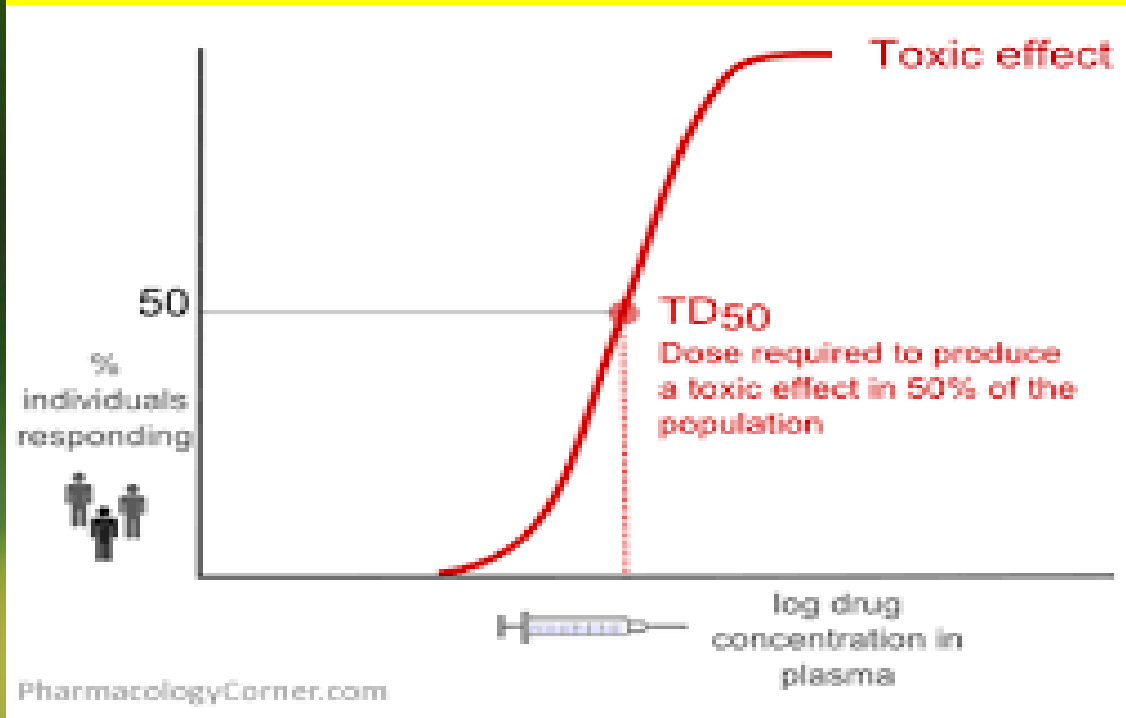




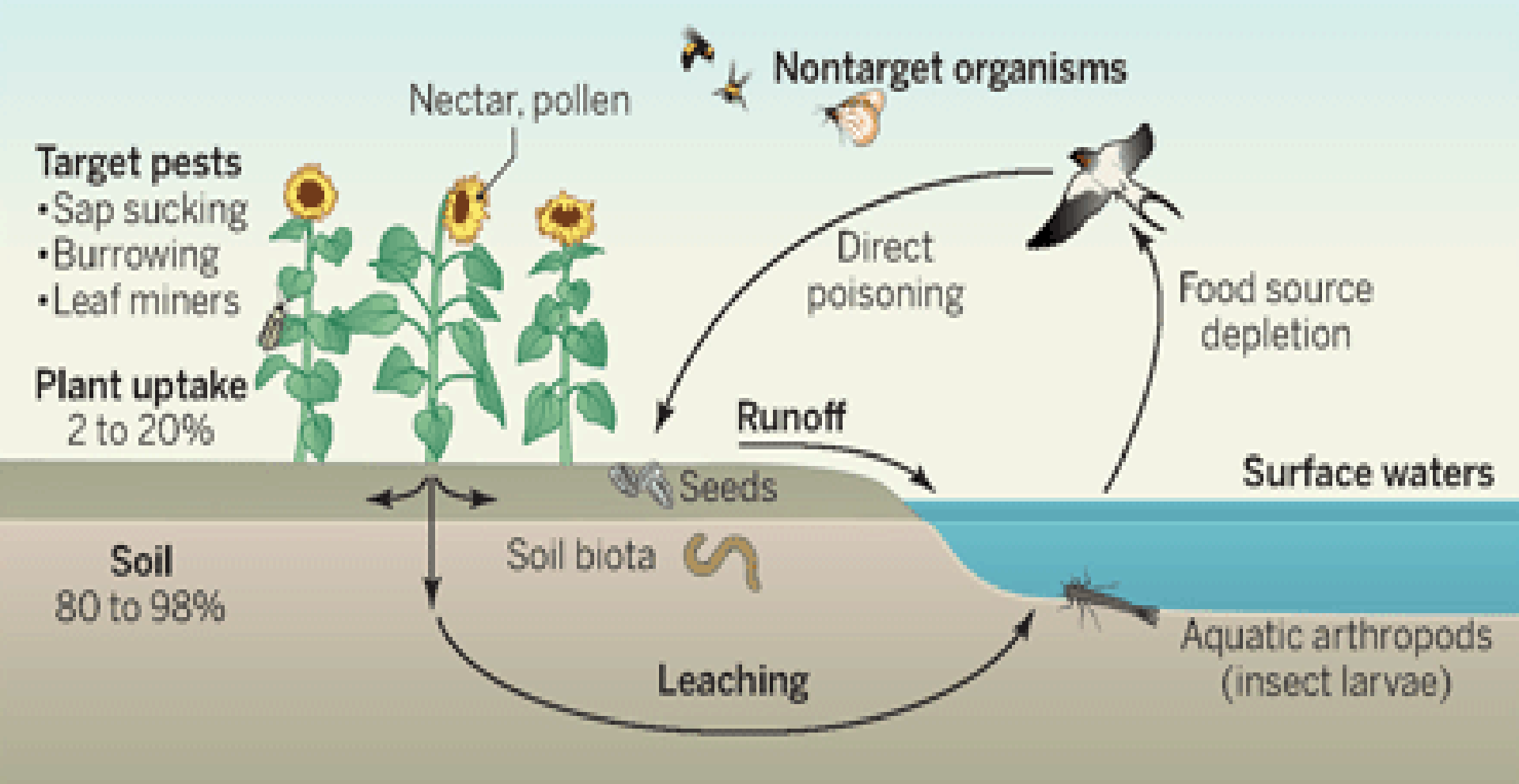
For more info

Issues with IPM in urban areas:

- **2018 Conserving the endangered rusty patched bumble bee; create habitat and decrease pesticide**
- **2020 Updated Insecticide toxicity to pollinators; are pesticides safe?**



Neonicotinoid birds + bees: Fate of neonicotinoids + pathways of environmental contamination (Sanchez-Bayo 2014 Science)



Understanding pesticide toxicity pollinators:

- LD50 based on 72, 96 hr exposure by oral, dermal, and inhalation routes.
- LD50 is lethal death to 50% of the test animals.
- Sublethal rates alter behavior and foraging and impact colonies.
- Herbicide active ingredients, AI, considered nontoxic to bees, but inert ingredients, adjuvants make them toxic.
- Fungicides toxic to bees

2020 Understanding Pesticide Toxicity to Pollinators

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Pesticide Toxicity to Pollinators

The active and inert ingredient can be found on the label on the pesticide container. The active ingredient is the chemical registered by the EPA as causing the toxicity of the product to the pest or beneficial insect. Recent papers demonstrate that inert ingredients are highly toxicity to bees as well. Inert ingredients are penetrating agents, odor maskers, stabilizers, preservatives, diluents, surfactants, emulsifiers, propellants, solvents, spreaders, stickers, antifoaming agents, dyes, and drift retardants that modify the physicochemical properties of the spray mixture. Some recent papers demonstrate that the inert ingredient called "organosilicone surfactant adjuvants" increase virus transmission in bees. Also, in recent studies fungicides demonstrated toxicity to bees. Another major issue is that the EPA registers the active ingredient and determines toxicity of the chemical based on short term, 4 day, LD 50 tests (lethal dose to 50% of the population) and not chronic, long term exposure. However, numerous papers are demonstrating that lower, sub-lethal amounts of pesticides affect behavior and alter the ability of insects to find food and survive. For these and numerous other reasons many insecticides are not safe to use around bees and other beneficial insects, such as lady beetles.

IPM: Systemic Compared to Contact Insecticides

The conservation of beneficial insects, that includes bees, insect predators, parasitic wasps, and butterflies, is an essential part of Integrated Pest Management (IPM) programs. IPM promotes multiple tactics to manage pests and to suppress the population size below levels that will damage the plant. Beneficial insects can only manage small, pest populations, when populations of pests are high, conventional insecticides must be used. For most pests that eat leaves, use contact insecticides that sit on the leaf surface and do not move into the plant and the toxicity to pests last for a few days on the foliage. Flowers that open after being sprayed with contact insecticides do not contain insecticide residue. Systemic insecticides move from the leaves or soil into OTHER plant parts as nectar and pollen. Flowers that open after systemic insecticides are sprayed can absorb the insecticide and the residue in leaves and flowers can last for many months.

Systemic, neonicotinoid insecticides are widely used, due to their low mammalian toxicity and the ability of the insecticide to move systemically from soil into the entire plant. However, they often move into pollen and nectar and when fed on by bees alter bee behavior or increase bee mortality. Application methods include seed treatments, foliar sprays, soil and trunk drenches, and trunk-injections. There are six systemic neonicotinoid active ingredients, imidacloprid, dinotefuran, thiamethoxam, clothianidin, acetamiprid and thiacloprid. You will find these active ingredients listed on the insecticide label in small print. Neonicotinoid insecticides are very toxic to bees and beneficial insects, especially as residue in pollen and nectar.

Manage with IPM by using cultural control, sanitation, biological control, using insecticides friendly to beneficial insects (low toxicity in the table). Remember "organic MRI approved insecticides" can be very toxic.

1. Scout for populations of both pest and beneficial insects, such as lady beetles and bees.
Determine if the good bugs are suppressing the pest bugs and no loss to flowering or food production can be found.
2. If beneficial insects are present and the pest population is increasing, then spray CONTACT insecticides on the foliage. Contact insecticides are degraded in a few days by light, water, and microbes.
3. Do not apply insecticides to flowers.
4. Spray contact insecticides on leaves in the evening when bees and lady beetles are not foraging.
5. Use insecticides that are less toxic to bees, such as oils, soaps, neem oil, Acelepryn (chlorantraniliprole), miticides, and insect growth regulators

Toxicity to pollinators of insecticides used in greenhouse, nursery, landscape.
Highlighted in gray are less toxic AI.

			Toxicity to honeybees**			
Chemical class/MOA	**Common name/MOA**	**Trade name**	**LD50* ug/bee**	**Non**	**Moderate**	**Highly**
Carbamates/1A	carbaryl	Sevin	0.014			x
	methomyl	Lannate	0.816			x
Neonicotinoids/4	imidacloprid	Merit, Marathon	0.004			x
	thiamethoxam	Flagship, Meridian	0.004			x
	clothianidin	Arena, Aloft	0.005			x
	dinotefuran	Safari, Venom	0.023			x
	imid+bifenthrin	Allectus	0.004			x
	imid+cyfluthrin	Discus	0.004			x
	flypyradifurone	Altus	1.2			x
	sulfloxaflor+spinetoram	XXpire cancelled	0.02+0.1			x
	acetamiprid	Tristar, Assail Calypso	14.5		x	
	thiacloprid		27.8	x		
Organophosphates/1B	acephate	Orthene	0.1082			x
	chlorpyrifos	Dursban/Lorsban	0.06			x
	dimethoate	Dimethoate	0.038			x
	malathion	Malathion	0.16			x
	phosmet	Imidan	0.1			x
Pyrethroids/3A	bifenthrin	Attain/Talstar	0.1			x
	cyfluthrin	Tempo, Decathalon	0.001			x
	fenpropathrin	Tame	0.05			x
	lambda-cyhalothrin	Scimitar	0.038			x
	permethrin	Astro, Pounce	0.029			x
	resmethrin	foggers	0.065			x
Botanical/3	pyrethrin	Pyganic	0.15			x
Insect growth regulators	diflubenzuron/15	Adept, Dimilin	25	x		
	tebufenozide/18	Confirm	234	x		
	azadirachtin/UN	Aza-Direct, Azatin	2.5		x	
	Neem oil		163	x		
	buprofezin/16	Talus	100	x		
	pyriproxyfen/7C	Distance, Fulcrom	100	x		
	novaluron/15	Pedestal	150	x		
	cyromazine/17	Citation	25	x		
Juvenile hormone /7A	s-kinoprene	Enstar II	35	x		
Anthranilic Diamides/28	chlorantraniliprole	Acelepryn	>104	x		
	cyantraniliprole	Mainspring	0.116			x
Macrocyclic lactones/6	abamectin	Avid, Sirocco	0.009			x
	emamectin-benzoate	Tree-age, Enfold	0.41			x
Miticides	acequinocyl/20B	Shuttle	>100	x		
	etoxazole/10B	TetraSan, Beethoven	200	x		
	fenpyroximate/21A	Akari, Vendex	162	x		

Insecticides: biorational, conventional, and organic

Conventional: Toxic to pests, bees, beneficials

Biorational: Compatible with bees and beneficials

Organic: OMRI approved natural products; toxic to good bugs

Neonicotinoids are 5,000-10,000X more toxic than DDT to bees

LD50 DDT … 27,0000ng/bee
LD50 neonicotinoid insecticides
Imidacloprid ……..4 ng/bee….40 ppb
Clothianidin ……..4 ng/bee….40 ppb
Dinotefuran ……..4 ng/bee….40 ppb
Thiamethoxam …..5 ng/bee….50 ppb

aspirin 80mg=80,000microg=80,000,000ng

Why are neonicotinoids so much more toxic to bees compared to other insecticides?

- **Receptors in bees not in mammals**
- **Adjuvants increase toxicity**
- **Alters behavior +foraging at sublethal doses**
- **Water soluable**
- **Binds with soil**

Why are bumblebee more susceptible to neonicotinoids?

- Honeybee queens never forage.
  Bumble bee queens forage in fall + spring.
- Honeybee colonies have 50,000 workers
  Bumble bee colonies have 30 workers.
- Honeybee forager is the last stage in lifecycle.
  Bumble bee workers forage at any age.
- Honeybee bread=pollen+ nectar+ saliva+ +hypo pharyngeal secretion, detoxifies
- Bumble bees do not make bee bread.

Glyphosate use increase

- 200 million lbs herbicides used annually
- Use has increased in farmland.
- 1993-1996 to 2014-2016 levels of glyphosate also spiked by 1208% during that time.
- In July 2017, in accordance with the Safe Drinking Water and Toxic Enforcement Act of 1986, the state of California listed glyphosate as a probable carcinogen.

Glyphosate affects bees

- **Glyphosate alters bee gut biota, reduces immunity, and increases infections. Motta et al. 2018. PNAS**

- **Glyphosate alters bee navigation; alters ability to read spatial information. Balbuena et al. 2015. J Exp Bio**

- **Glyphosate affects the larval development of HB, causing reduced wt and delayed molting Vazquez et al. 2018. Plosone**

Zhang et al. 2019. Exposure to glyphosate-based herbicides and risk non-hodgkin lymphoma: Meta-analysis. Mutation Research

- **Meta-analysis that included the most recent update of the *Agricultural Health Study*(AHS) cohort published in 2018 that reported on 54,000 people who work as licensed pesticide applicators along with five case-control studies.**
- **We report the overall meta-relative risk of NHL in GBH-exposed individuals was increased by 41%.**

Differences in the carcinogenic evaluation of glyphosate…Portier and 94 authors 2018 J epidemiol community health

The most appropriate and scientifically based evaluation of the cancers reported in humans and laboratory animals as well as supportive mechanistic data is that glyphosate is a probable human carcinogen.

Insecticides: biorational, conventional, and organic

Conventional: Toxic to pests, bees, beneficials

Biorational: Compatible with bees and beneficials

Organic: OMRI approved natural products; toxic to good bugs

Characteristics of biorational insecticides

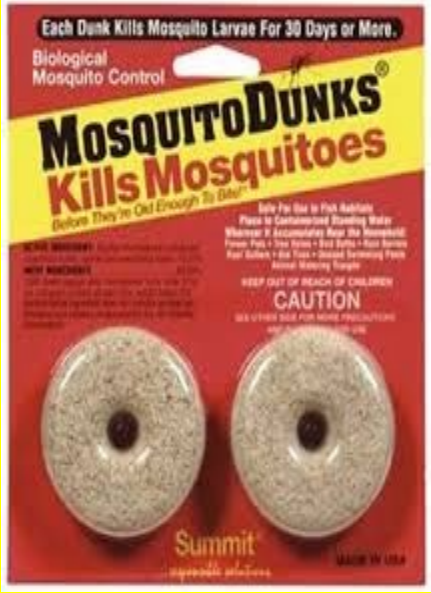
- Short residual
- Degrade due to light, water, microbes.
- Work on smaller insects and immatures
- Less harmful to beneficial insects, predators, parasitoids, bees.
- Low mammalian toxicity.
- May take longer to kill a pest.

Use biorational insecticides for bees

Acelepryn, chlorantraniliprole for grubs in soil and on landscape plants
Spinosad for caterpillars and sawflies
Neem oil, soaps, and oils for aphids
Need imidacloprid or dinotefuran for borers




Use biorational insecticides for bees: BT, *Bacillus thuringiensis*



- BT is a protein crystal that puts an hole in the insect's gut wall after ingestion.
- BT kurstaki, moth larvae, Dipel, Javelin
- BT aizawai, moth larvae and suckers, Xentari
- BT tenebrionis, beetle larvae, Trident
- BT galleria, grubs, Grubgone
- BT israelensis, fly larvae, Aquabac
- Burkholderia, caterpillars, Venerate

Use biorational insecticides for bees

Parasitic nematodes: *Steinernema carpocapsae, Heterorhabditis bacteriophora*

Insecticides: biorational, conventional, and organic

Conventional: Toxic to pests, bees, beneficials

Biorational: Compatible with bees and beneficials

Organic: OMRI approved natural products; toxic to good bugs

What is organic pest control?

- Organic means a practice that is governed by certifi[illegible] in each state to grow food without the use of synthetic pesticides in soils that are considered living and maintained by adding organic materials and not synthetic fertilizers.
- The National Organic Standards Board (NOSB)advises the National Organic Program (NOP).
- An organic certification is obtained from a USDA certified organic agency.
- The OMRI Organic Materials Research Institute has a list of organically approved products. Excluded are nitrogen(N), phosphate (P), or potash/potassium (K), and ammonia and nitrate fertilizers.

Outline: Endangered species

- Why are some species endangered and others florish?

  Habitat loss and pesticide use contribute
- Rusty-patched bumblebee
- Changing the paradigm; bee lawns; reduce herbicide use + cosmetic use; reducing glyphosate; neonics birds
- IPM, BMP, OMRI, oh my
- What you can do.

Reduce pesticide use: Understanding the partial contribution of pesticides to bee mortality and developing BMP to mitigate mortality

- **Use contact insecticides**
- **Not use systemic neonicotinoid insecticides**
- **Reduce herbicide use**
- **Do not use fungicides w/o diagnosis**
- **Promote bee lawns**

Save the bees by planting flowers and trees

1. Use contact insecticides on flowering plants, such as bifenthrin, cyfluthrin, Bt, soaps, insect growth regulators
2. Do not use systemic insecticides.
3. Plant a seasonal phenology of native and garden plants for nectar and pollen.
4. Only single-flowered plants, not double flowers, provide pollen and nectar.
5. Provide overwintering habitat for bees.
6. Do not kill queen bees in the spring/fall, they will not sting.
7. Understand the different types of bees and wasps so you can conserve bees.

Krischik lab websites

IPM resources for greenhouses and ornamentals
http://cues.cfans.umn.edu/

Pollinator Conservation
https://ncipmhort.cfans.umn.edu/

MNLA online course fro certification training for MDA pesticide license
https://pesticidecert.cfans.umn.edu/

Educational materials on IPM

- Tree insects
- Turf insects
- Beneficial insects
- Greenhouse insects, biological control, and insecticides
- Biocontrol insects to release in greenhouse
- Pollinator Conservation
- Beneficial insect conservation
- Christmas Tree IPM
- 2018 March 9 talk Christmas tree meeting, IPM for firs
- 2014 USDA FS Christmas Tree Manual
- 2016 OSU diagnostic manual firs
- 2013 PSU insecticide bulletin
- 2014 PSU fungicide bulletin
- 2017 OSU herbicide bulletin
- Pesticide registration in

Welcome to CUES, Center for Urban Ecology and Sustainability! You will find practical information on IPM, insect identification, insecticide choice, and conserving beneficial insects in greenhouse, nurseries, landscapes, and Christmas trees.

CUES Mission Statement

CUES strives to educate landscape managers and urban residents about ways to embrace environmental stewardship by practicing sustainable management. A landscape managed through sustainable methods requires low inputs of labor, fertilizers, herbicides, insecticides, and fungicides, while supporting beneficial insects, bees, butterflies, and birds. Excessive use of these chemicals can pollute surface and ground water and disturb natural ecosystem processes.

Sustainable management embraces four major principles:

1. **conserving biodiversity**
   The naturally diverse landscape discourages outbreaks of disease or insects. Such a landscape also attracts beneficial insects, bees, birds and butterflies.
2. **restoring native vegetation**
   Consider using native vegetation in landscapes. Restore native vegetation to shorelines to reduce nutrient enrichment through stabilizing sediments and shorelines.
3. **promoting nutrient recycling through composting**

Book on IPM of Midwest landscapes, click to read all the book chapters

Click to order IPM of Midwest landscapes

Recent talks and handouts

- 2018 May 7 MG Henn Managing JB
- 2018 Feb 22 webinar profit by enhancing biocontrol in greenhouse/nursery, landscape, and turf.pdf
- Beneficial insects
- 2018 Feb 20 webinar managing Japanese beetles.pdf
- Acelepryn factsheet
- Acelepryn label
- Acelepryn section 2ee label
- Multistate EAB recommendations
- 2018 Updated Krischik insecticide toxiicity to pollinators

Pests of Trees and Shrubs

Alder spittlebug	*Clastoptera obtusa*
Ambrosia beetle	*Xylosandrus germanus*
American hornet moth	*Sesia tibialis*
Aphids	Family Aphididae
Apple bark borer	*Synanthedon pyri*
Arborvitae leafminer	*Argyresthia thuiella*
Ash flower gall mite	*Aceria fraxiniflora*
Ash plant bug	*Tropidosteptes amoenus*
Asian longhorned beetle	*Anoplophora glabripennis*
Azalea lace bug	*Stephanitis pyrioides*
Bagworm	*Thyridopteryx ephemeraeformis*
Balsam twig aphid	*Mindarus abietinus*
Banded ash clearwing	*Podosesia aureocincta*
Birch lace bug	*Corythuca pallipes*
Birch leafminer	*Fenusa pusilla*
Black pineleaf scale	*Nuculaspis californica*
Black vine weevil	*Otiorhynchus sulcatus*
Boxelder bug	*Boisea trivittatus*
Boxwood spider mite	*Eurytetranychus buxi*
Bronze birch borer	*Agrilus anxius*
Brownheaded ash sawfly	*Tomostethus multicinctus*
Calico scale	*Eulecanium cerasorum*
Cankerworms	*Alsophila pometaria, Paleacrita vernata*
Clearwing borers	Family Sesiidae
Clover mite	*Bryobia praetiosa*
Cooley spruce gall adelgid	*Adelges cooleyi*
Cottonwood leaf beetle	*Chrysomela scripta*
Cottony maple scale	*Pulvinaria innumerabilis*
Currant borer	*Synanthedon tipuliformis*
Cyclamen mite	*Phytonemus pallidus*
Lesser peachtree borer	*Synanthedon pictipes*
Lilac/ash borer	*Podosesia syringae*
Linden borer	*Saperda vestita*
Locust borer	*Megacyllene robiniae*
Maple bladdergall mite	*Vasates quadripedes*
Maple callus borer	*Synanthedon acerni*
Maple spindlegall mite	*Vasates aceriscrumena*
Maple velvet erineum gall mite	*Aceria aceris*
Mimosa webworm	*Homadaula anisocentra*
Mountainash sawfly	*Pristiphora geniculata*
Mourningcloak butterfly	*Nymphalis antiopa*
Oak borer	*Paranthrene simulans*
Oak clearwing borer	*Paranthrene asilipennis*
Oak cynipid galls	Family Cynipidae
Obscure scale	*Melanaspis obscura*
Oriental beetle	*Exomala orientalis*
Oystershell scale	*Lepidosaphes ulmi*
Pales weevil	*Hylobius pales*
Peachtree borer	*Synanthedon exitiosa*
Pear sawfly	*Caliroa cerasi*
Pin oak kermes	*Allokermes galliformus*
Pine bark adelgid	*Pineus strobi*
Pine engraver	*Ips pini*
Pine needle scale	*Chionaspis pinifoliae*
Pine root collar weevil	*Hylobius radicis*
Pine shoot beetle	*Tomicus piniperda*
Pine spittlebug	*Aphrophora parallela*
Pine thrips	*Gnophothrips* sp.
Pine tortoise scale	*Toumeyella parvicornis*
Pitch mass borer	*Synanthedon pini*

Pollinator Conservation Biocontrol

Welcome. In addition to biocontrols, this website provides how-to instructions, plant lists, helpful links, videos and downloads on beneficial insect and pollinator conservation, insect identification, integrated pest management (IPM), and pollinator best practices for backyards, veggie gardens and parks & open spaces. Find course registration and class materials under resources, courses.

This website contains the following topics:

- Integrated pest management (IPM)
- Pesticides and pollinators
- Best practices for pollinators introduction
- Krischik lab research staff
- Krischik lab at work
- Research projects

Integrated Pest Management

Integrated Pest Management (IPM) is an ecosystem-based approach that employs long-term prevention of pests and pest damage through monitoring of plants, pests and weather to project ahead and plan. IPM addresses the source of the pest problems, whereas pesticides simply respond to pests. IPM minimizes the use of chemicals harmful to pollinators and beneficial insects, and toxic to the environment. The recommended best practice is to use cultural controls to reduce pest populations such as compost, bio fertilizers and aeration instead of pesticides.

Integrated pest management practices include:

1. Inspection and monitoring: Regular and close examination of plants is essential to diagnose pest problems. Monitoring includes devices such as traps, and practices such as observation and recordkeeping.
2. Forecasting: Weather and plant growth cycles (called plant phenology) help predict potential pest outbreaks. Properly timed pesticide applications will be more effective and reduce need for re-application.
3. Thresholds: Set thresholds for pest populations and plant damage. Use hardy plants that are naturally resistant to pests to avoid exceeding pest thresholds. Accept some plant damage.
4. Education: Regularly update the IPM plan and pesticide/treatment list so it remains effective. Stay educated and updated on IPM and best management practices.
5. Recordkeeping: Keep updated records to compare year to year and for decision-making. Track data including weather patterns, when pests appear, number of pests, plant damage, and practices that work and don't work.

Minnesota Threatened and Endangered Species

Excerpt from *Environmental Quality Board, Minnesota State Agency Pollinator Report 2018.*

Federally endangered


Cole Nordmeyer
Poweshiek skipperling


JK Hollingsworth
Karner blue butterfly


Marcie Forsberg
Rusty-patched bumble bee

Federally threatened


Bryan Reynolds
Dakota skipper

Under review for federal listing


Bill Keim
Yellow-banded bumble bee


Laurie Schneider
Monarch butterfly

Endangered: Persius duskywing, Ottoe skipper, Dakota skipper, Assiniboia skipper, Uncas skipper, Karner blue, Poweshiek skipperling, Uhler's artic.
Threatened: Garita skipperling.
Special Concern: Arogos skipper, Disa alpine, Leonard's skipper, Nabokov's blue, Grizzled skipper, Regal fritillary.

In addition to federally-listed species, Minnesota has **8** state-listed endangered pollinator species, **1** threatened, **10** species of special concern, and an additional **19** non-listed species in greatest conservation need.

Think IPM

for pollinator conservation Integrated Pest Management

BIOLOGICAL CONTROL

is the use of natural enemies to control insect pest populations. Natural enemies include insect predators and parasitoids (such as lady beetles and braconid wasps) plus pathogens including bacteria, fungi and viruses.

PLANT NATIVE & HEIRLOOM

plants that provide pollen and nectar to attract natural predators. Many are attracted to flowering plants and also contribute to pollination services.

INTEGRATED PEST MANAGEMENT

is an ecosystem-based approach that employs long-term prevention of pests through inspection, monitoring, forecasting, thresholds, education and recordkeeping. While pesticides simply respond to the pest, IPM addresses the source of pest problems.

LAWN CARE

Limit insecticide/herbicide use, aerate, mow less often, less grasses grow to 4" or more, add nutrient-rich compost, and plant low growing perennials such as self-heal, clover, creeping thyme, blanket flowers, and pussy toes.

MONITORING

Long term prevention through regular monitoring of plants, pests and weather helps to project ahead and plan. Track and compare year to year to determine what works best.

CHEMICAL CONTROLS

Biorational insecticides are less harmful than conventional insecticides, as they target pests and conserve good bugs (eg. horticultural soaps and oils, corn gluten, spinosad and *Bacillius thuringiensis*).

CONSERVE POLLINATORS

Bees, flies, wasps, beetles and other pollinators are crucial for crops, landscapes, and natural areas. Avoid pesticides, provide nesting areas, and plant pollinator habitat for food sources.

ncipmhort.dl.umn.edu

By Dr. Vera Krischik and Laurie Schneider
University of Minnesota, Dept. of Entomology
Center for Urban Ecology & Sustainability CUES

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND
Legislative-Citizen Commission on Minnesota Resources (LCCMR)
Conservation Biocontrol 2017-2020

Pollinator Friendly Alliance

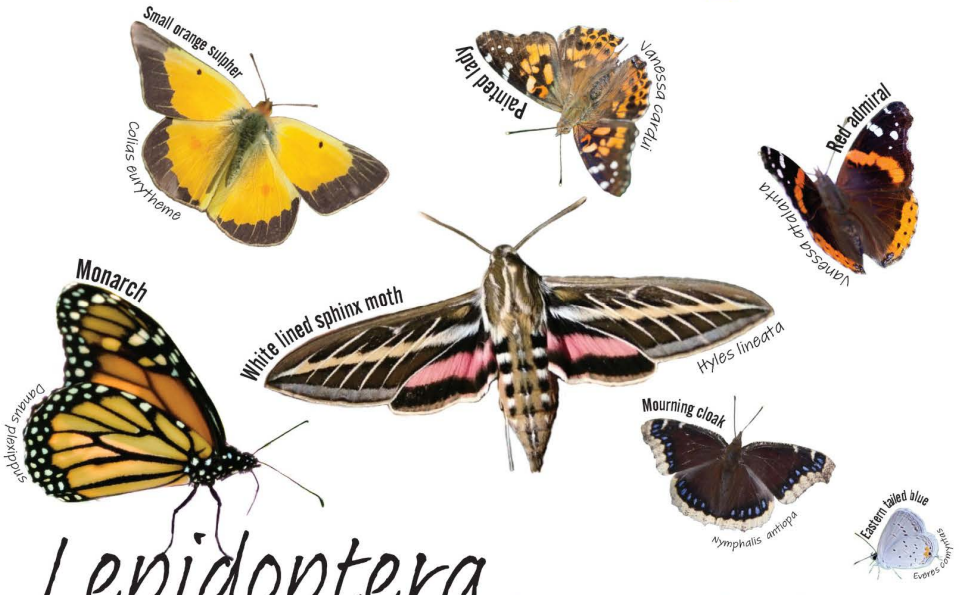
LACEWING
Predator of aphids. Known as aphid lions.

PIRATE BUG
Adults and nymphs are predators of small insects.

SPIDERS
Arachnids eat many pest insects at any stage from egg to adult.

SYRPHID FLY or HOVER FLY
Adults feed on pollen and nectar. Larvae are predators on small insects.

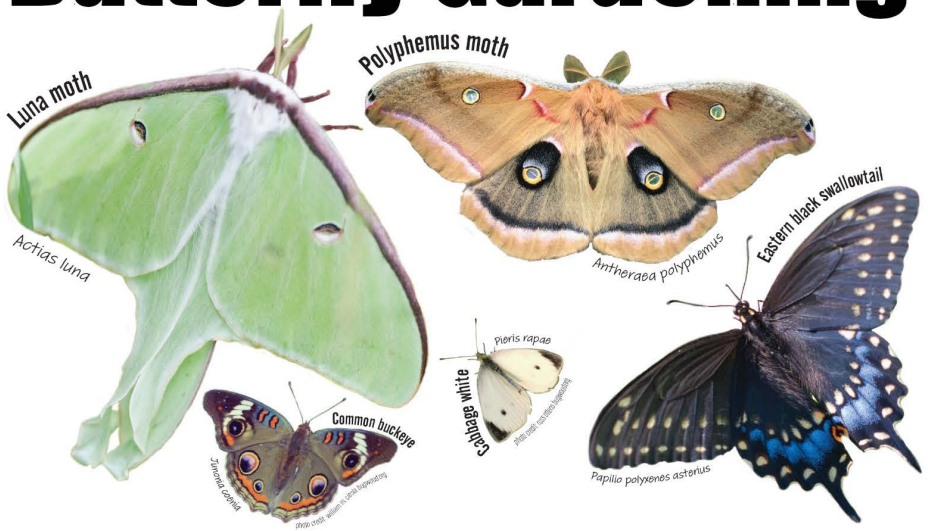
LADY BEETLES
Larvae and adults are predators of small insects.



Lepidoptera

by Dr. Vera Krischik, University of Minnesota, Entomology
Center for Urban Ecology & Sustainability, CUES, 2020

Butterfly Gardening



Research Projects

On this page, you will find a summary and detail for recent research projects by Principal Investigator, Dr. Vera Krischik, and her research staff on beneficial insect and pollinator conservation including biocontrol, land management best practices, and pesticide effects on pollinators and beneficial insects.

Click here for Dr. Vera Krischik's biography.

Click here for complete list of publications by Dr. Vera Krischik.

Effects of chronic insecticide exposure on bumble bees

Declines in bee populations around the world have been attributed to various factors, one of which is pesticide use. The purpose of this project was to examine the toxicity of several insecticides to bumble bees (*Bombus impatiens*). We found that chlorantraniliprole (4 ppm), an insecticide commonly used for Japanese beetle control, was less toxic to bees than the neonicotinoid clothianidin (0.02 ppm). Also, clothianidin resulted in a decrease in brood production and movement

University of Minnesota

Vera Krischik, Department of Entomology, krisc001@umn.edu

LCCMR, August 2017 - June 2020 Conservation Biocontrol

Activity 1A: Conservation biocontrol in restorations. Research and outreach educational programs will be performed to conserve beneficial insects by researching different cultural tactics in restorations.

New IPM outreach bulletins on Best IPM Practices for Back yard Landscape, Best IPM Practices for Open Spaces, Guide to IPM, Pollinator Lawn IPM, Butterfly Gardening booklet, Butterfly & Plant ID booklet, Conserving Rusty Patched Bumble Bee, Conservation Guide , poster Think IPM

Research on best habitat for nesting and overwintering beneficial insects called beetle banks were installed at 3 sites in Washington county. At a citizen science field day, 36 banks at 3 sites had a mean of 131 insects in a sample of 10% of each beetle bank compared to control plots with 1 insect.

Research on best habitat for native stem nesting bees called reed huts were installed at 3 sites in Washington county. At a citizen science field day, 36 reed bee huts were inspected at 3 sites which contained 236 occupied reeds or 95% of the huts occupied by nesting bees.

Research on best larval host plants and adult nectar plants for Minnesota butterflies are listed in bulletins.

Activity 1B: Conservation biocontrol in restorations. Wild flowers in restorations will be investigated for pesticide residue levels that may affect beneficial insect conservation.

Outreach poster, Think IPM; **Outreach talks were** 4 workshops/year and 28 talks/year to professionals and consumers. **Outreach website at** https://ncipmhort.dl.umn.edu

Research on LD50 of butterflies and residue of insecticide in the field permit correlation of field doses of insecticides on survival and behavior of butterflies and bumble bees.

Research on pesticide residue on flowers near potato fields showed that 100% of 36 samples tested contained at least 2 and up to 15 different pesticides.

Research on pesticide residue on flowers near corn fields showed that of 40% of 32 samples tested contained only 1 pesticide and it was atrazine.

Activity 2: Beneficial insect friendly pesticides. Research will investigate what pesticides conserve beneficial insects.

Outreach IPM bulletins describe IPM practices based on our research that will conserve bees, butterflies, and other beneficial insects that kill pests.

Research on Acelepryn, a bee-friendly insecticide used for killing Japanese beetles showed that bumble bees are able to tolerate 4 ppm sub-lethal dose. In contrast, Monarch and Painted lady butterfly larvae are killed at 0.030 ppm dose, around 133 times less than bumble bees. bifenthrin

Research showed that Monarch and Painted lady butterflies tolerated higher doses of imidacloprid and clothianidin, and bifenthrin than bumble bees.