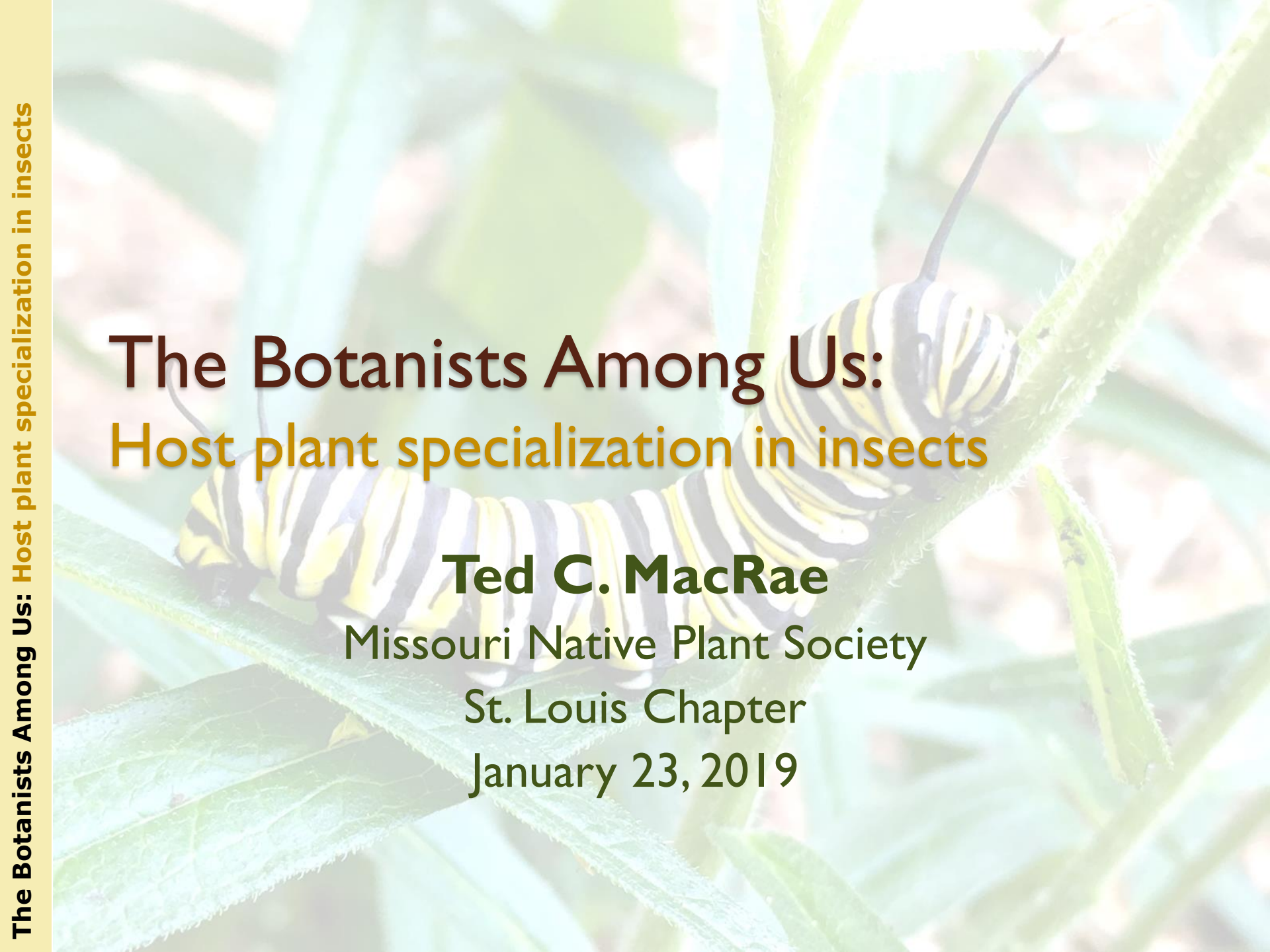

The Botanists Among Us:
Host plant specialization in insects

Ted C. MacRae
Missouri Native Plant Society
St. Louis Chapter
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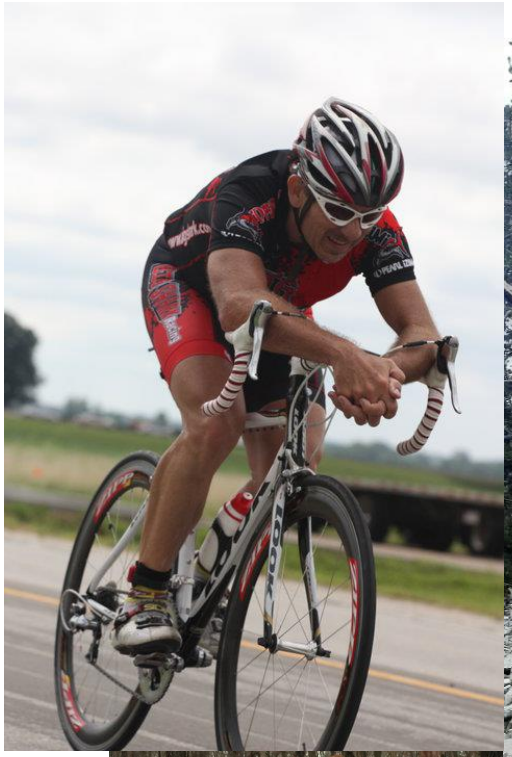
Introductions

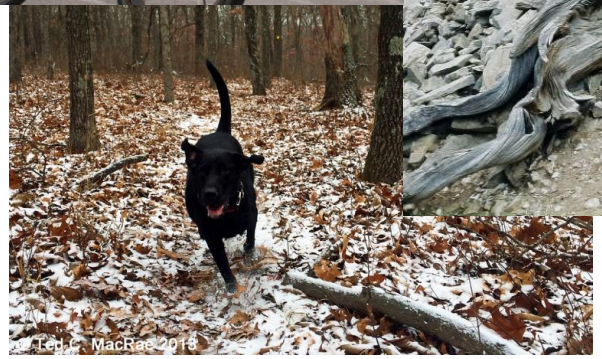
- Grew up in Kansas City (city boy!)
- B.S. Agriculture 1979, University of Missouri
- M.S. Entomology 1981, University of Missouri
- 1982–1990: Missouri Department of Agriculture, St. Louis, MO
- 1990–1995: Novo Nordisk Entotech, Davis, CA
- 1995–present: Bayer Crop Sciences (formerly Monsanto), Chesterfield, MO

I'm never happier than when I am studying insects…

…or photographing them…

…or doing pretty much anything outdoors…





…except when I am with my girls!

Outline

- Major groups of plant-feeding insects
- Evolutionary themes of plant-feeding
- Examples of different types of host-plant specificity

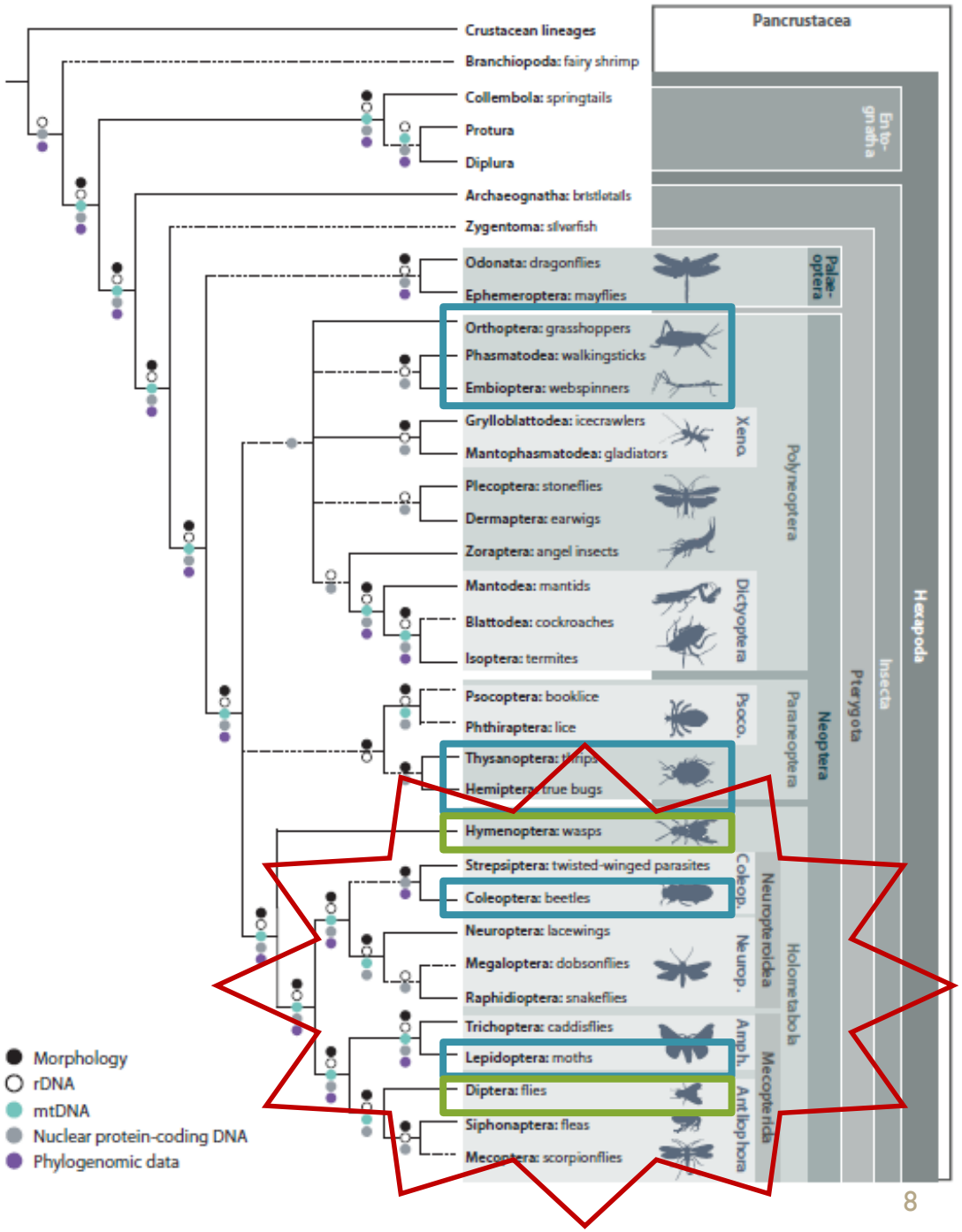
Plant-feeing insects are found predominantly within four main groups:

1. Orthopteroidea (grasshoppers & kin)
2. Hemipteroidea (true bugs & thrips)
3. Coleoptera (beetles)
4. Lepidoptera (moths)

Two additional groups with plant-feeding species:

1. Hymenoptera (wasps)
2. Diptera (flies)

Most plant-feeders (indeed, most insects) are holometabolous (distinct larval stage).



Orthopteroidea

Grasshoppers
Crickets
Katydids
Walkingsticks

- Majority phytophagous
- Katydids diversified in late Mesozoic with diversification of flowering plants (leaf mimicry).
- Grasshopper evolution coincided with the origin and radiation of grasslands.

Red-eyed Devil – A Predaceous Katydid

Mouthparts: Bite or Suck!

Sucking
Bugs
Flies
Butterflies/Moths
(adults)

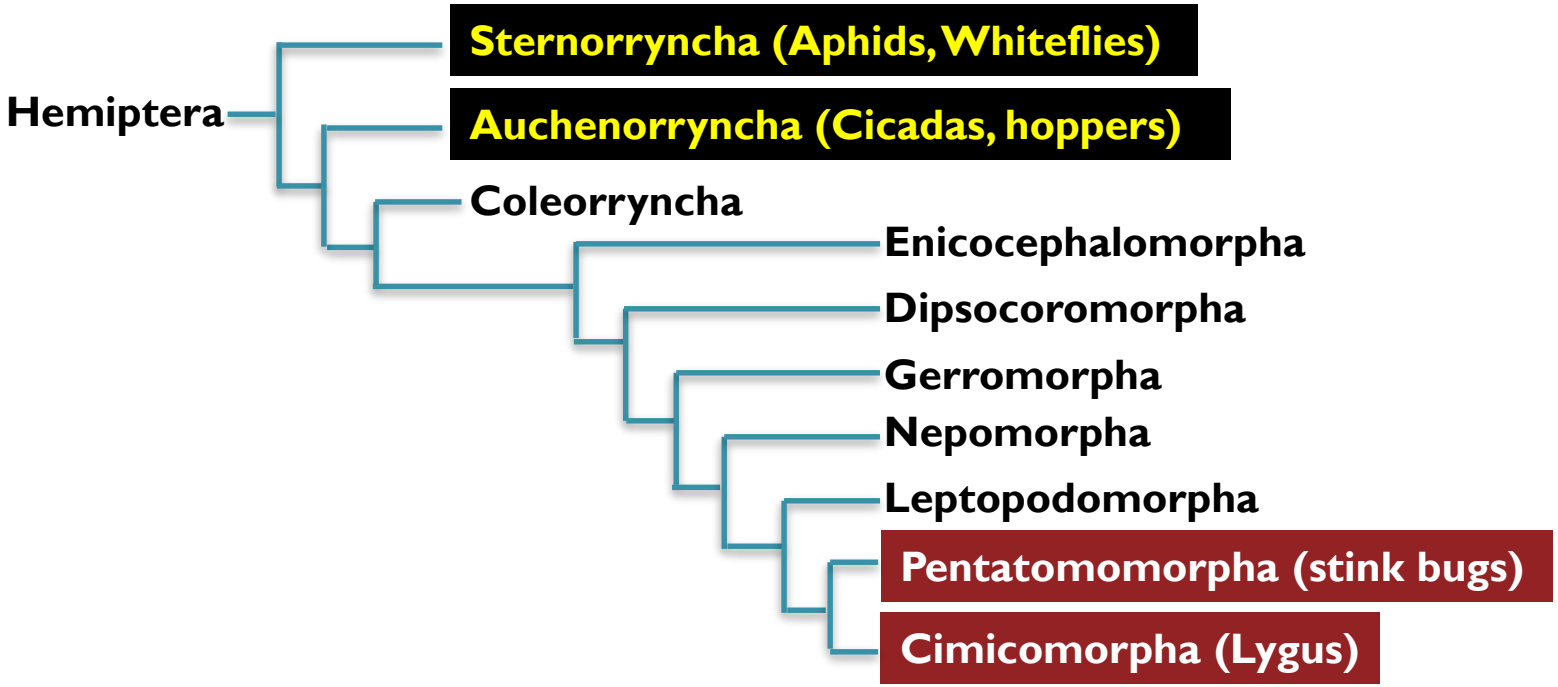
Chewing
Grasshoppers
Beetles, Wasps &
Butterflies/moths
(larvae)

Hemiptera

True Bugs

- Piercing/sucking mouthparts
  - Mandibles/maxillae = "stylets"
  - Labium = "sheath"
  - Collectively = "beak"
- Basal groups phytophagous
- Beak coopted for predation
- Secondary phytophagy evolved from predators

Phylogeny of Phytophagous Hemiptera



- Sternorryncha feed from vascular bundles.
- Auchenorryncha and true bugs practice extraoral digestion of whole tissues.

Thysanoptera

Thrips

- "One thrips, two thrips…"
- Mouthparts asymmetrical right mandible modified for "rasping/sucking"
- Many species are pests of row crops and ornamental plants

Larvae – the ultimate eating machines!

Coleoptera

Beetles

- Forewings became protective covering – early beetles lived under bark, leaf litter
- Allowed evolution of predaceous groups, then a great diversity of lifestyles.
- Phytophagy appeared multiple times but is most prevalent in higher groups (leaf beetles and weevils).

Order Coleoptera
"Plant Feeders"

Lepidoptera

Moths, Butterflies

- Vast majority are phytophagous
- There are predaceous groups!
- Specialized group of day fliers (butterflies) use visual cues and are chemically protected

Lepidopteran caterpillars can be extraordinary!

Hymenoptera

Wasps, Ants & Bees

- Basal groups are plant feeders
- Parasitic and predaceous lifestyles evolved later
- Bees returned to plant-feeding habits as part of nest-provisioning lifestyle, making them important pollinators

Sawflies & horntails
plant feeders
"basal hymenopterans"

Order Diptera

Flies

- Primitive groups with aquatic larvae and blood feeding adults
- Secondary phytophagy in a few groups (internally in plants (e.g., Hessian fly)
- Adults of many groups important pollinators

Milkweed Specialists

Milkweed Specialists

Monarch butterfly (*Danaus plexippus*)

Milkweed tussock moth (*Euchaetes egle*)

Small milkweed bug, *Lygaeus kalmia* (family Lygaeidae), feeds exclusively on the seeds of milkweeds (*Asclepias* spp.).

False milkweed bug, *Lygaeus turcicus* (family Lygaeidae) resembles the small milkweed bug, *L. kalmii*, but feeds exclusively on the seeds of false sunflower, *Heliopsis helianthoides*.

Swamp milkweed leaf beetle (*Labidomera clivicollis*) on swamp milkweed (*Asclepias incarnata*). This species can and does feed on other milkweeds and related genera belonging to the family Asclepiadaceae.

The common milkweed beetle (*Tetraopes tetrophthalmus*) (family Cerambycidae) (left) occurs on the broadly distributed common milkweed (*Asclepias syriaca*), while the much rarer *T. texanus* is restricted to green-flowered milkweed (*A. viridiflora*).

A milkweed beetle, *Tetraopes quinquemaculatus* (family Cerambycidae)
On green-flowered milkweed (*Asclepias viridiflora*)

A Gulf Fritillary, *Agraulis vanillae* (family Nymphalidae), caterpillar feeding hungrily on the foliage of maypop (*Passiflora incarnata*), its only host plant.

Western pygmy blue (*Brephidium exilis*)

Specialists of Other Plants

Pussytoes (*Antennaria plantaginifolia*) are one of a few related host plants of American lady butterfly (*Vanessa virginiensis*). The larvae tie/skeletonize the leaves.

Euhagena nebraskae (family Sesiidae) develops in the roots of plants in the evening primrose family (Onagraceae). An eastern relative (*E. emphytiformis*) occurs in Jefferson Co. glades and presumably breeds in *Oenetherea gaura* and/or *O. macrocarpa*.

Adult males of the common bagworm (*Thyridopteryx ephemeraeformis*) (family Psychidae). The larvae form "bags" on a variety of trees and shrubs—especially ornamental evergreens.

The "mallow caterpillar", *Tarache delecta* (family Noctuidae) on hairy rose mallow (*Hibiscus lasiocarpus*). This species feeds exclusively on species of *Hibiscus*.

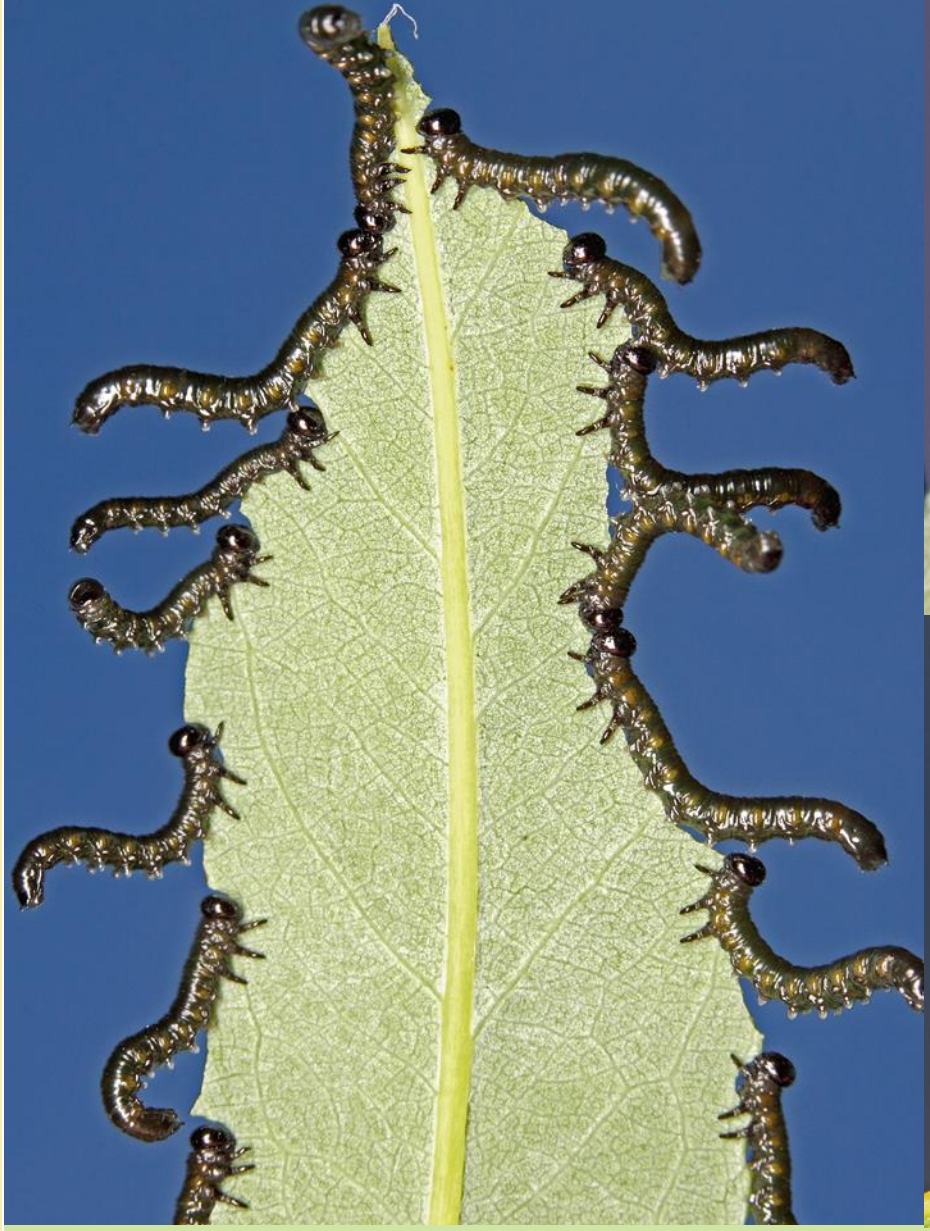
Cactus bugs (*Chelinidea vittiger*) (family Coreidae)
Prickly pear cactus (*Opuntia humifusa*) is their only host

Woolly maple aphids, *Neoprociphilus aceris* (family Aphididae, subfamily Eriosomatinae) colonize a branch of sugar maple (*Acer saccharum*).

The ninebark leaf beetle (*Calligrapha spiraeae*) on ninebark (*Physocarpus opulifolius*). Beetles in this genus are among the most host-specific of all phytophagous beetles, with most of the 38 species relying upon a single plant genus as hosts.

One of several "willow leaf beetles", *Chrysomela knabi* (family Chrysomelidae) is common on willow (*Salix* spp.)—esp. sandbar willow (*S. interior*)—during spring.

A seed weevil, *Althaeus hibisci* or *A. folkertsi* (family Chrysomelidae) on rose mallow (*Hibiscus moscheutos lasiocarpus*). These beetles measure only 1.5–2.5 mm in length.



The willow sawfly, *Nematus ventralis* (family Tenthredinidae), is a wasp, not a caterpillar!
The species can be abundant on willow but also feeds on cherry (*Prunus* spp.).
Both host plants contain antifeedant compounds!

Sawfly larvae (prob. Family Tenthredinidae) skeletonizing oak *(Quercus* sp.). Most sawfly species tend to be rather host specific.

A leaf mine on hop hornbeam (*Ostrya virginiana*). Several groups of flies and beetles have adapted a leaf mining life history. Their small, highly flattened larvae feed between the upper and lower surfaces of the leaf, leaving behind these serpentine mines.

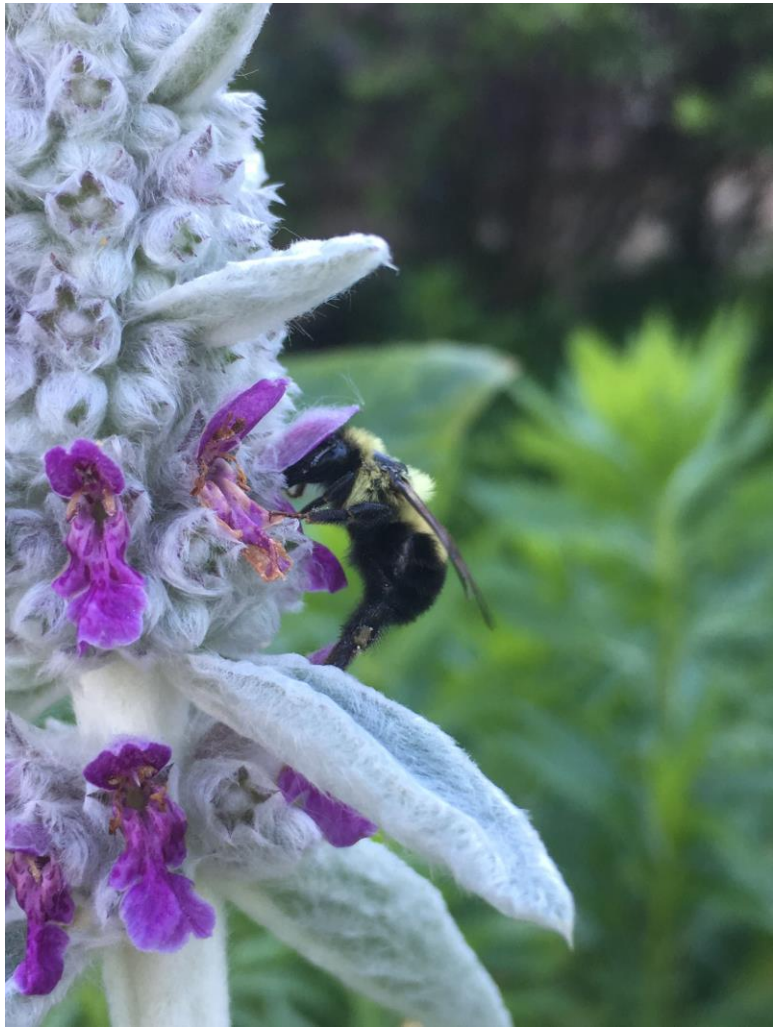
Goldenrod leaf miner, *Microrhopala vittata* (family Chrysomelidae), specializes on goldenrods (*Solidago* spp. and *Euthamia graminifolia*). This keystone species promotes woody plant invasion in old field communities, speeding the transition to a tree-dominated community.

A leaf-mining jewel beetle, *Brachys ovatus* (family Buprestidae). This species is commonly associated with oaks during spring – I have collected it on ten of Missouri's 21 oak species

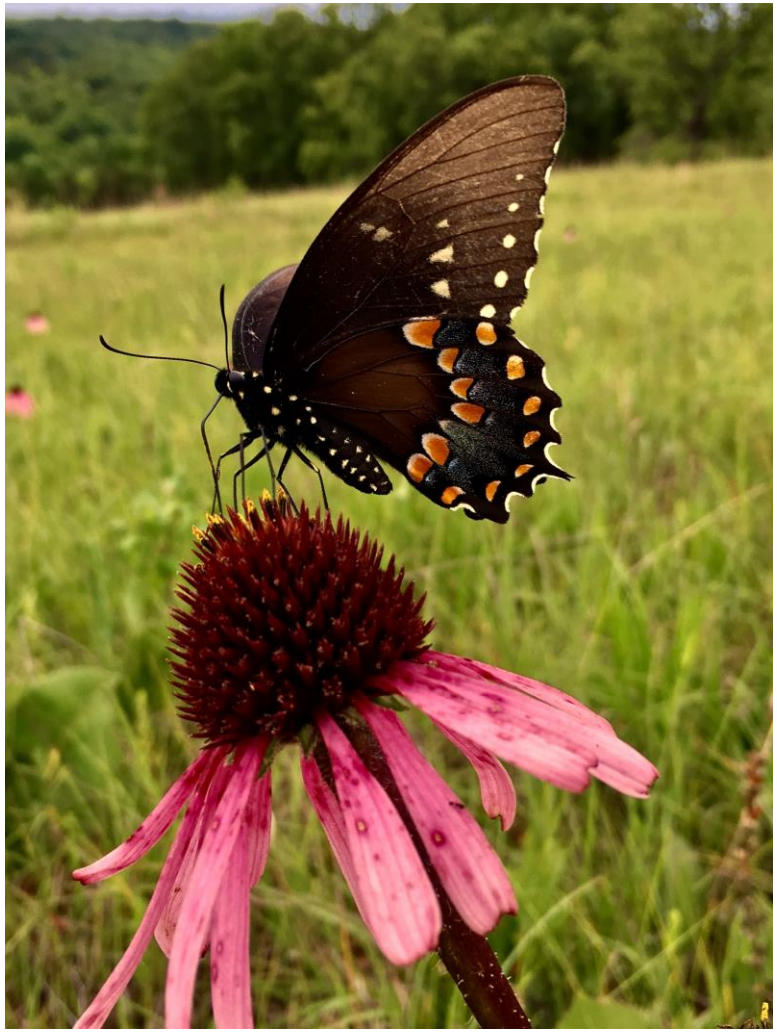
Rush skeletonplant (*Lygodesmia juncea*) with galls of *Antistrophus lygodesmiaepisum* (Hymenoptera: Cynipidae). This insect depends exclusively on this plant, thus its presence in Missouri is tied directly to the survival of remnant loess hill prairies.

Orange-patched smoky moth (*Pyromorpha dimidiata*), one of the "leaf-skeletonizer moths" (family Zygaenidae). Larvae are reported to feed on oak leaf litter. Adults mimic lycid beetles and possess chemical defenses of their own.

Pollinators



Native bumble bee (*Bombus* sp.)



Spicebush swallowtail butterfly (*Papilio troilus*)

Pennsylvania solider beetles (*Chauliognathus pennsylvanicus*) feed on sunflower (*Helianthus* spp.), goldenrod (*Solidago* spp.), and other yellow composites during fall

A flower jewel beetle, *Acmaeodera tubulus* (family Buprestidae)
On flower of eastern beebalm (*Monarda bradburiana*)

Another flower jewel beetle, *Acmaeodera ornata* (family Buprestidae)
On flower of ox-eye daisy (*Leucanthemum vulgare*)

A flower longhorn, *Typocerus deceptus* (family Cerambycidae) on flowers of wild hydrangea (*Hydrangea arborescens*)

Another flower longhorn, *Strangalia luteicornis* (family Cerambycidae) on flowers of wild hydrangea (*Hydrangea arborescens*)

And still another flower longhorn, *Brachyleptura rubrica* (family Cerambycidae) on flowers of wild hydrangea (*Hydrangea arborescens*)

And finally the last (I promise!) flower longhorn, *Typocerus lugubris* (family Cerambycidae) on flowers of wild hydrangea (*Hydrangea arborescens*)

A tiny, ant-mimicking longhorned beetle, *Tilloclytus geminatus* (family Cerambycidae) on flowering dogwood (*Cornus florida*).

Buprestis salisburyensis (family Buprestiedae)
on Virginia pine (*Pinus virginiana*)

Wood Boring Beetle Specialists

Like many longhorned beetles (family Cerambycidae), *Elytramitatrix undata* doesn't care what host species it feeds on—just as long as the wood is dead!

Purpuricenus paraxillaris, a longhorned beetle (family Cerambycidae)
Breeds in dead branches of oaks (*Quercus* spp.)

A longhorned beetle, *Acanthocinus nodosus* (family Cerambycidae) on trunk of shortleaf pine (*Pinus echinata*). This is one of many in the family restricted to pines.

The honey locust borer, *Agrilus difficilis* (family Buprestidae) is another species in the genus that breeds in living host plants, this one only in honey locust (*Gleditsia triacanthos*).

This jewel beetle, *Agrilus pseudofallax* (family Buprestidae), is one of several species in the genus that breed in dead wood of honey locust (*Gleditsia triacanthos*).

The persimmon borer (*Dicerca obscura*) (family Buprestidae) breeds almost exclusively in trunks and branches of dead persimmon (*Diospyros virginiana*).

Unlike most other jewel beetles, *Agrilus fuscipennis* (family Buprestidae) breeds in the living tissues of its only host plant, persimmon (*Diospyros virginiana*).

The elderberry borer (*Desmocerus palliatus*) (family Cerambycidae) breeds exclusively in the living stems and roots of common elderberry, *Sambucus nigra* ssp. *canadensis*.

The ninebark borer, *Dicerca pugionata* (family Buprestidae). Unlike most members of the genus, which breed in dead wood, larvae of this species mine the living stems of ninebark (*Physocarpus opulifolius*).

"North America's most beautiful longhorned beetle", the bumelia borer (*Plinthocoelium suaveolens*) (family Cerambycidae) is found in dolomite glades where it breeds exclusively in gum bumelia (*Sideroxylon lanuginosa*).

The amorpha borer (*Megacyllene decora*) (family Cerambycidae) breeds in living stems of false indigo (*Amorpha fruticosa*), while adults are highly preferential to flowers of goldenrod (*Solidago* spp.) and snakeroot (*Eupatorium* spp.).

The dectes stem borer, *Dectes texanus* (family Cerambycidae) breeds in the living stems of sunflower (*Helianthus* spp.), ragweed (*Ambrosia* spp.), and other asteraceous plants. It has recently adapted to soybean, on which this individual was photographed.

"North America's most beautiful *Agrilus* jewel beetle", *Agrilus concinnus* (family Buprestidae), is restricted to the living stems of rose mallow (*Hibiscus* spp.). Good populations can be seen in mid- to late summer in the southeastern lowlands of Missouri.

Thank You!

See more of my photographs at:

Beetles in the Bush*

(just Google it!)

* http://beetlesinthebush.wordpress.com