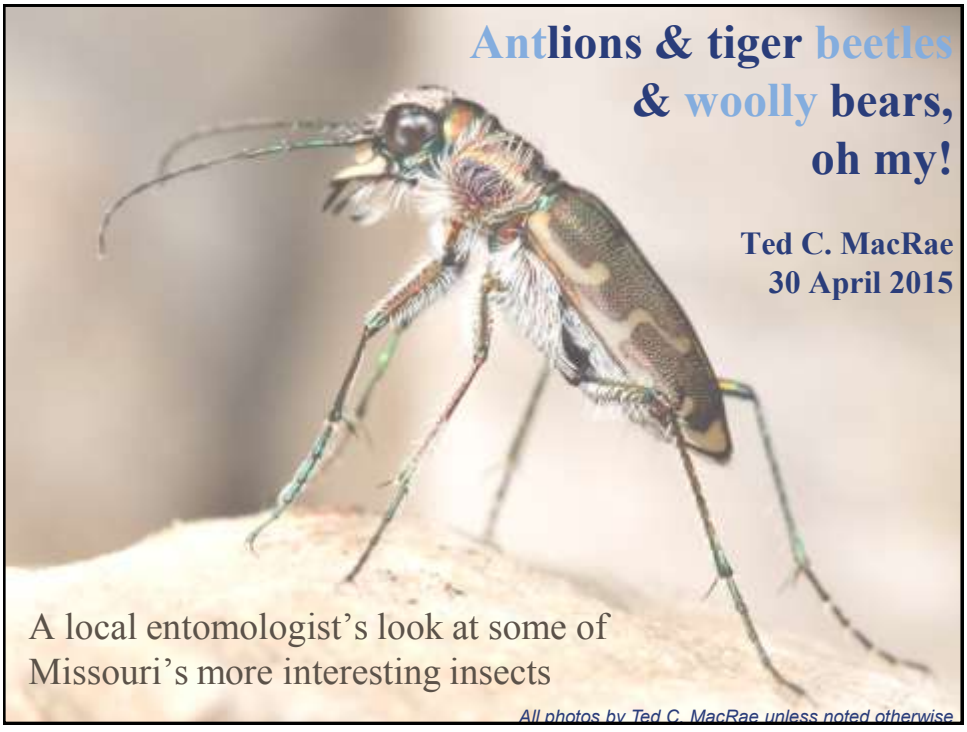


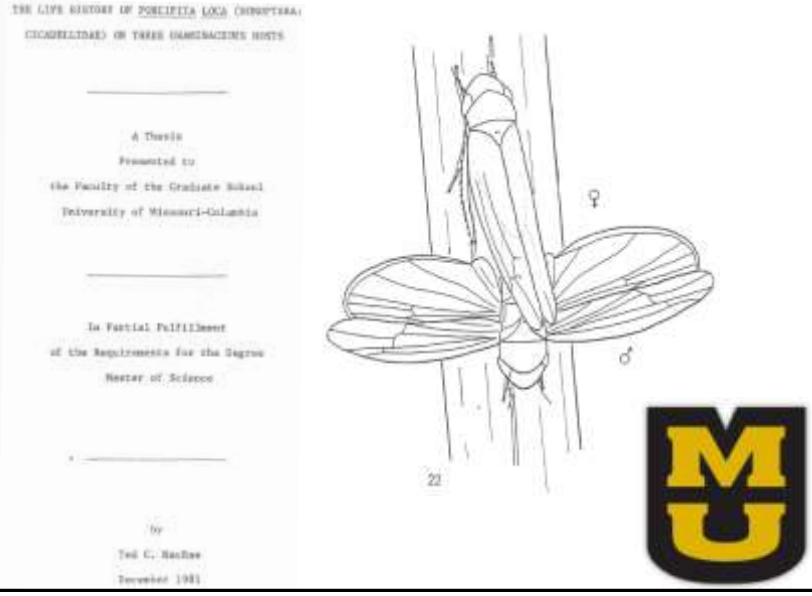
Who Am I?

- Grew up in Kansas City (yes, I'm a 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: Monsanto Company, Chesterfield, MO

First photo by Christopher

Discovering Entomology: collected insects as hobby during childhood, then seriously starting in college

Photos by unknown (L), Carol Zimmermann (R)



THE LIFE HISTORY OF FORCIPITA LOCA (HOMOPTERA: CICADELLIDAE) ON THREE GRAMINACEOUS HOSTS

A Thesis
Presented to
the Faculty of the Graduate School
University of Missouri-Columbia

In Partial Fulfillment
of the Requirements for the Degree
Master of Science

by
Ted C. MacRae
December 1981

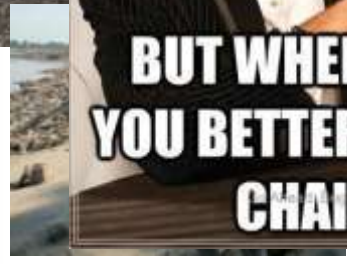
I'm never happier than when I am studying insects…




Photos (clockwise from upper left) by Chuck Bellamy, unknown, Rich Thoma, & self

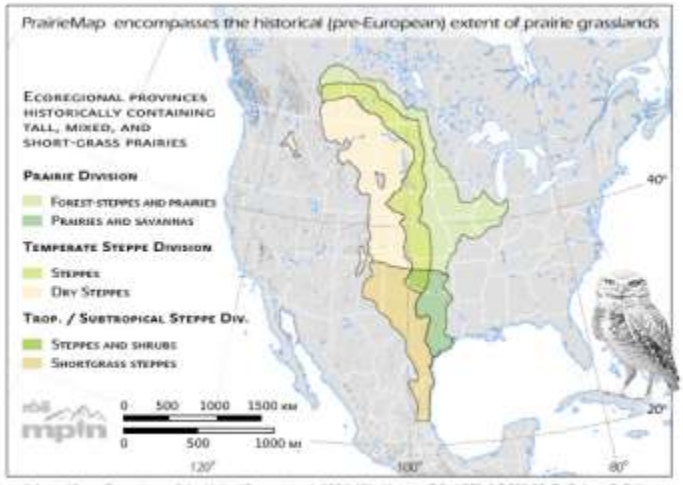
…or pho them



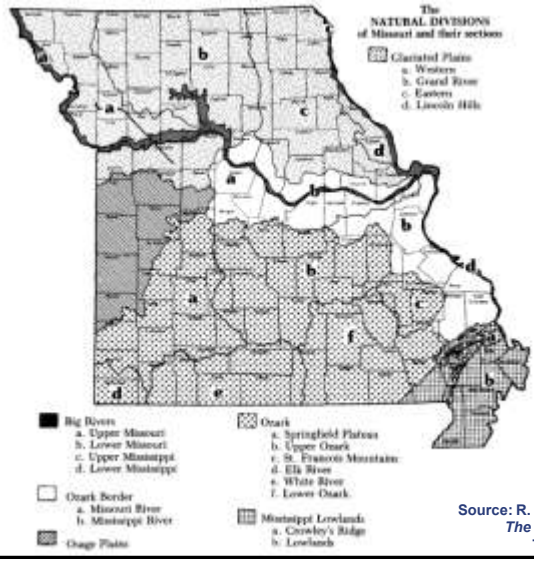
…se from upper left) Kent Fothergill, Rich Thoma, Lisa Ruschke , unknown

Missouri: where forest yields to prairie



Adapted from: Ecoregions of the United States. (map). 1994. Washington DC: USFS. 1:7,500,00. By Robert G. Bailey.

The Natural Divisions of Missouri



Source: R. H. Thom & J. H. Wilson. 1980. *The Natural Divisions of Missouri.* Trans. MO Acad. Sci. 14:9–23.

Insects in the Glaciated Plains

Insects in the Loess Hills

- Snakeweed grasshopper, *Hesperotettix viridis*
- Prairie May beetle, *Phyllophaga lanceolata*
- Common milkweed beetle, *Tetraopes tetrophthalmus*

Desmocerus palliatus (Coleoptera: Cerambycidae)
Associated with *Sambucus canadensis* (elderberry)

Hypsithermal relicts

- Relicts from hypsithermal period that began 9,000 yrs ago
- Include skeletonweed (right) and soapweed yucca (*Yucca glauca* var. *glauca*)
- More than a dozen plant species occurring in Missouri's dry loess prairies are listed as species of conservation concern
  - Reptiles - Great Plains skink
  - Mammals - Plains pocket mouse
  - But no insects!
- Considered endangered due to great rarity of dry loess prairie

Skeletonweed, *Lygodesmia juncea*

A Possible Insect Candidate?

Antistrophus lygodesmaepisum, a cynipid gall wasp



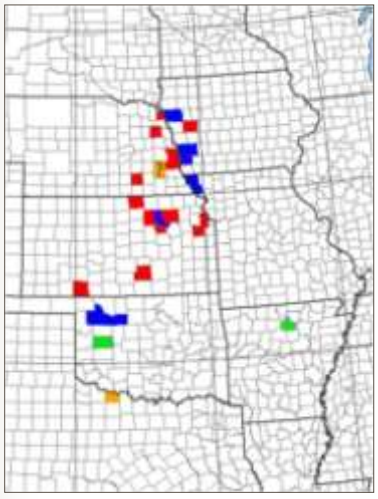

Other Possible Insect Candidates?

Robber fly, *Ospriocerus abdominalis*

A prairie-obligate cicada, *Beameria venosa*

Cylindera celeripes (Swift Tiger Beetle)
Our smallest tiger beetle (only 6 mm length)

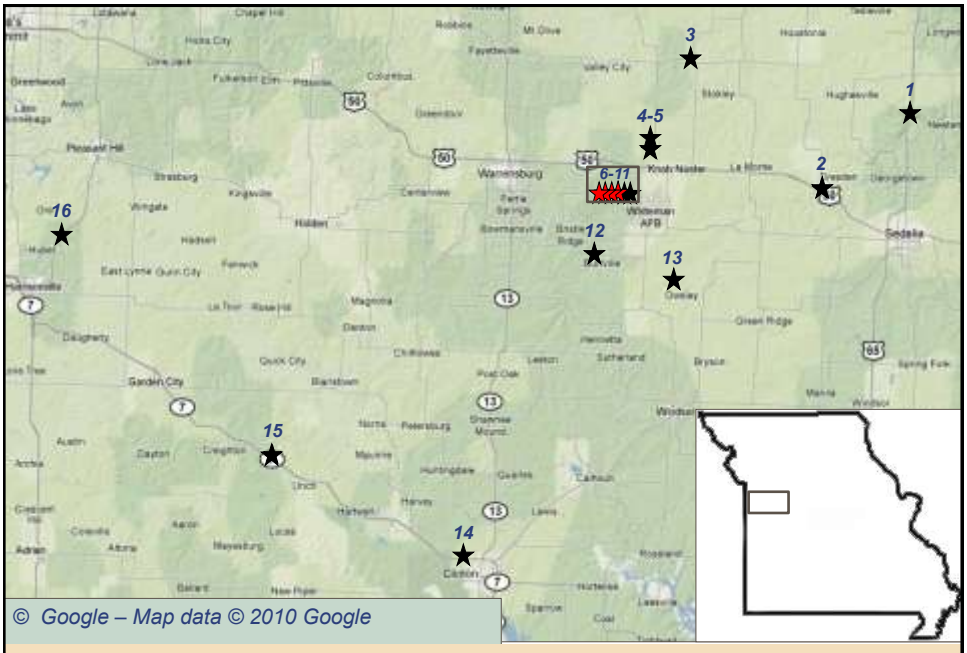
Cylindera celeripes habitat and distribution



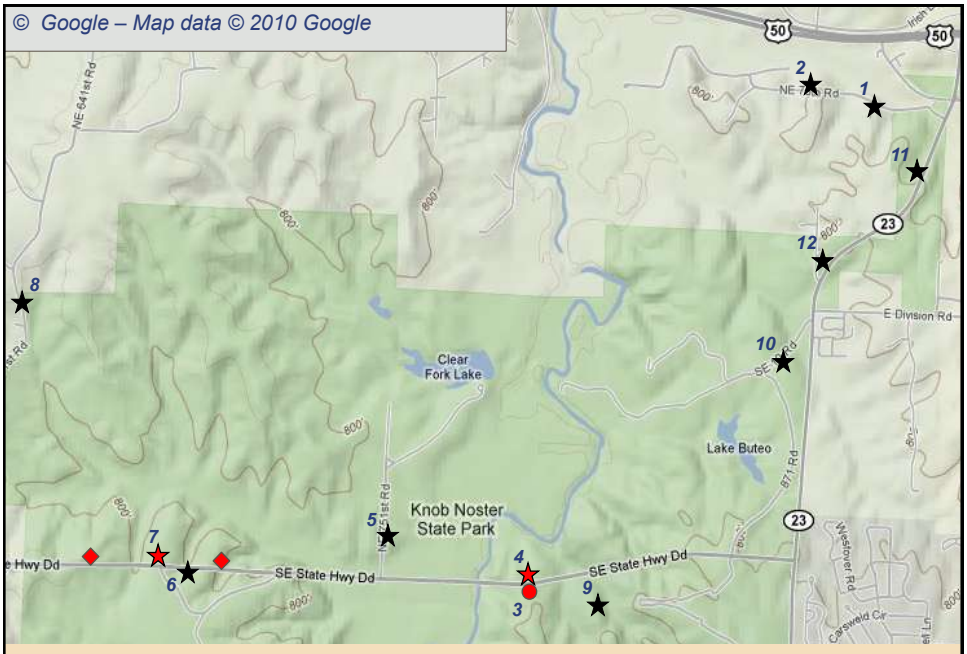
Insects in the Osage Plains

Canthon chalicites (Coleoptera: Scarabaeidae: Scarabaeinae)
One of the “dung-rollers”

Dromochorus pruinina (Frosted Dromo Tiger Beetle)
Restricted to 2.4-mile stretch of clay exposures in west-central Missouri



Frosted Dromo Tiger Beetle survey—Phase 1 (2006)



Frosted Dromo Tiger Beetle survey—Phase 2 (2008)

Insects in the Ozark Highlands

Megaphasma denticrus (Phasmida: Diapheromeridae)
North America's longest insect

Magicicada sp. (Hemiptera: Cicadidae)
Brood XIX—every 13 years in Missouri (2011, 1998, 1985…)

Polistes carolina/perplexus (Hymenoptera: Vespidae)
with *Magicicada* prey—an example of **predator satiation**

Cicindela sexguttata (Six-spotted Tiger Beetle)
Most commonly encountered tiger beetle in Missouri

Calosoma sayi (Coleoptera: Carabidae: Carabinae)
Molecular data suggest tiger beetles are nested within Carabinae

Necrophila americana (Coleoptera: Silphidae)
Eat not only carcasses but also maggots that compete for it

Geotrupes splendidus miarophagus (Coleoptera: Geotrupidae)
Until recently treated as a subfamily of Scarabaeidae

Dynastes tityus (Coleoptera: Scarabaeidae)
North America's largest scarab beetle—not rare in Missouri's forests

Trigonopeltastes delta (Coleoptera: Scarabaeidae: Cetoniinae)
Species in this subfamily are mostly diurnal and found on flowers

Acmaeodera tubulus (Coleoptera: Buprestidae)
Adults are common in spring on a variety of flowers

Buprestis rufipes (Coleoptera: Buprestidae)
Larvae mine the wood of a variety of hardwoods

Dicerca lurida (Coleoptera: Buprestidae)
Larvae mine the wood of dead hickory (*Carya* spp.)

Enoclerus ichneumoneus (Coleoptera: Cleridae)
Larvae are predators of woodboring insects

Graphisurus triangulifer (Coleoptera: Disteniidae)
Nocturnal, somber coloration functions in crypsis while at rest on bark

Elytrimitatrix undata (Coleoptera: Disteniidae)
A close relative of the “true” longhorned beetles (family Cerambycidae)

Molorchus bimaculatus (Coleoptera: Cerambycidae)
Adults are part of an ant-mimicry complex

Tilloclytus geminatus (Coleoptera: Cerambycidae)
A different approach to ant mimicry

Cyrtinus pygmaeus (Coleoptera: Cerambycidae)
North America's smallest longhorned beetle

Calligrapha spireae (Coleoptera: Chrysomelidae)
Adults and larvae feed on foliage of *Physocarpus opulifolius* (ninebark)

Arrhenodes minutus (Coleoptera: Brentidae)
Different jaws for different jobs

Adela caeruleella (Lepidoptera: Incurvariidae)
Males can have antennae up to 3× the length of the forewings

Thyridopteryx ephemeraeformis (Lepidoptera: Psychidae)
Larvae tie silken/twig bags to ornamental and evergreen shrubs

Stylogaster neglecta (Diptera: Conopidae)
Adults take nectar; larvae are endoparasites of various insects

Tachinomyia sp. (Diptera: Tachinidae)
"I have a love-hate-love relationship with tachinids"—Terry Wheeler

Tremex columba (Hymenoptera: Siricidae)
Not all woodboring insects are beetles

Able to thrust a needle-thin ovipositor several cm into solid wood!

Pelecinus polyturator (Hymenoptera: Pelecinidae)
One of three species representing a once great lineage—"living fossils"

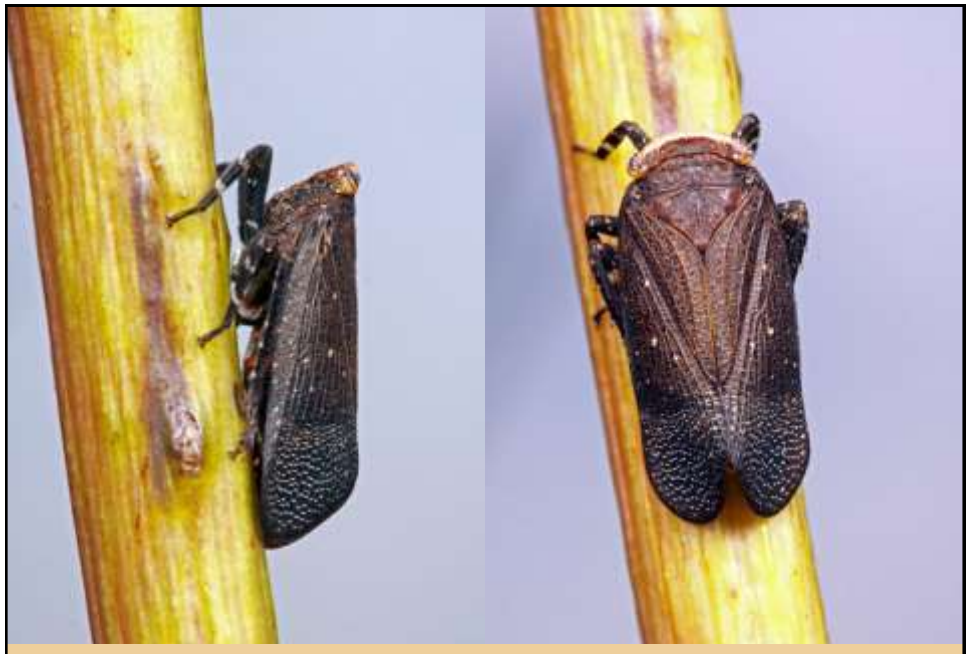
Limestone/dolomite glades

Centruroides vittatus (Arachnida: Scorpiones)
A perfect example of **cryptic coloration**

He's smiling!

Aphonopelma hentzi (Arachnida: Araneae: Theraphosidae)
Reach their northeastern limit of distribution just south of St. Louis

Hippiscus ocelote (Orthoptera: Acrididae)
Adults exhibit **cryptic coloration** at rest and **flash coloration** in flight



Poblicia fuliginosa (Hemiptera: Fulgoridae)
"Impossible to capture… rocket propelled. A most frustrating exercise in futility"—Vernon Brou, Jr.

Cicindelidia obsoleta vulturina (Prairie Tiger Beetle)
Large, powerful flier, occurs only in glades in the White River Hills

Cicindelidia obsoleta vulturina (prairie tiger beetle)

Map 55 Large Grassland Tiger Beetle, *Cicindela (Cicindelidia) obsoleta*; A, *C. o. obsoleta*; B, *C. o. neojuvenilis*; C, *C. o. santaclarae*; D, *C. o. vulturina*.

Map 55 Source: Pearson et al. (2006) *Tiger Beetles of the United States and Canada.* Oxford University Press, 236 pp.

Dicerca pugionata (Coleoptera: Buprestidae)
Larvae mine the stems of living *Physocarpus opulifolius* (ninebark)

Plinthocoelium suaveolens (Coleoptera: Cerambycidae)
Larvae bore in the roots of living *Sideroxylon lanuginosa* (gum bumelia)

Microstylum morosum (Diptera: Asilidae)
North America's largest robber fly—recently discovered in SW Missouri

Tettigidea lateralis (Orthoptera: Tetrigidae)
A “gigantic” pygmy” grasshopper measuring ~15mm in length

Dineutus sp. poss. *ciliata* (Coleoptera: Gyrinidae)
Calm waters sport frenzied beetles

Chimarra sp. (Trichoptera: Philopotamidae)
No coiled proboscis, prominent palps, and hairy vs scaled wings

Insects along the Big Rivers

Cicindela repanda (Bronzed Tiger Beetle)
Ubiquitous along watercourses throughout the state

Arctosa littoralis (Arachnida: Araneae: Lycosidae)
Found nocturnally on sandy beach along Mississippi River

He’s smiling!

A fantastic collecting site!

Working with *Cerceris fumipennis*




Insects in the Mississippi Lowlands

Agrilus concinnus (Coleoptera: Buprestidae)
Larvae form galls in lower stems of native mallows (*Hibiscus* spp.)

Agraulis vanillae (Lepidoptera: Nymphalidae: Heliconiinae)
Stunning colors advertise a toxin-laced body (**aposematic coloration**)

Megacyllene decora (Coleoptera: Cerambycidae)
Flower-visiting habit requires form of protection—in this case **mimicry**

Synanthedon rileyana (Lepidoptera: Sesiidae)
Larva feed on horse nettle common to sandy areas—**extreme mimicry**

Synchlora sp. (Lepidoptera: Geometridae)
Larvae adorn their bodies with bits of the plants upon which they feed

Cylindera cursitans (Ant-like Tiger Beetle)
Resembles Swift Tiger Beetle—marking connected, legs not metallic

Cylindera cursitans survey

- Wet bottomland forests
- "Radical" understory
- Sandy ridge/swale topography
- Occurrence outside of Mississippi Alluvial Plain uncertain

Sand Prairies—a critically endangered habitat

Sand prairies in Missouri

- Sand prairies are scattered throughout Missouri
- Occur primarily in the Mississippi Alluvial Plain, the northern tip of which extends into extreme southeastern Missouri
- Two main sand ridges – Sikeston Sand Ridge and Malden Sand Ridge
- Only the Sikeston Sand Ridge still contains significant sand prairie remnants

Sand prairie insects

Bembix americana (Crabronidae)

Stichopogon trifasciatus (Asilidae)

Chelinidea vittiger (Coreidae)

Ammophila procera (Sphecidae)

Pseudomethoca simillima (velvet ant)
Diurnal parasitoids of bees and wasps with a powerful sting!

Bombylius sp. (bee fly)
Larvae are parasitoids of the larvae of solitary bees

Cuterebra buccata (Diptera: Cuterebridae)
Rabbit parasite usually found in the neck/shoulder or rump/hip area

Sand loving neuropterans

Ascalaphidae (owlflies), *Ululodes macleayanus*

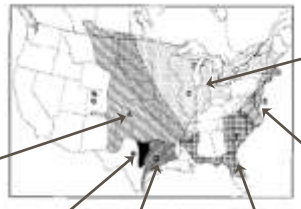
Myrmeleontidae (ant lions), *Myrmeleon* sp.

Larval coloration functions extremely well as camoflauge

Myrmeleon sp. larva next to burrow (L) and removed (R)

Cicindela formosa generosa (Big Sand Tiger Beetle)
One of my favorite tiger beetles in Missouri

Cicindela scutellaris (Festive Tiger Beetle)
North America's most polytopic tiger beetle!

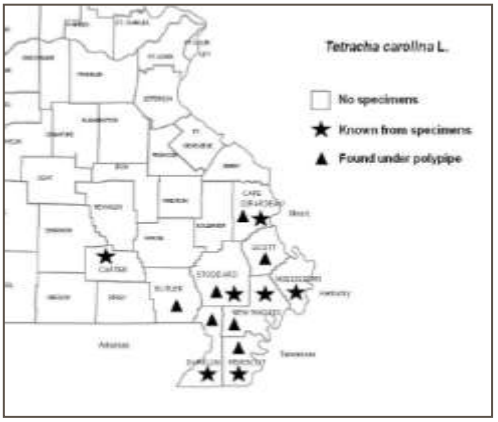


Map 43 ... Festive Tiger Beetle, *Cicindela* (*Cicindela*) *scutellaris*: A, *C. s. scutellaris*; B, *C. s. flavoviridis*; C, *C. s. lecontei*; D, *C. s. nugata*; E, *C. s. rugifrons*; F, *C. s. unicolor*; G, *C. s. vernalis*

Missouri's intergrade population

Tetracha carolina (Carolina Metallic Tiger Beetle)
Similar to *T. virginica* but slightly smaller, white apical marking

Tetracha carolina "polypipe" survey

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