

The Hopkins Notes and Records System and its value for contemporary research

Robert R. Kula

Systematic Entomology Laboratory
USDA-ARS, Washington, DC

Floyd W. Shockley

Smithsonian Institution, NMNH

American Chestnut

Amc once accounted for ~25% of trees in eastern forests



- pathogenic fungus introduced in ~1904 via nursery stock from Asia

- enters via wounds & kills cambium; girdles tree prior to producing nuts - chestnut blight

- Amc ecologically extinct by ~1930; nut-producing trees in historical range in hundreds, but thousands of sprouts remain



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American Chestnut

- efforts to restore Amc in U.S. forests using hybrid “restoration chestnut;” Amc x Chinese chestnut (6%); blight-resistant
- transgenic chestnut: 1 wheat gene inserted into Amc genome; Federal approval necessary before propagation



American Chestnut

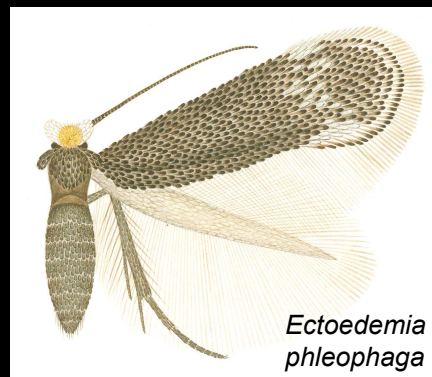
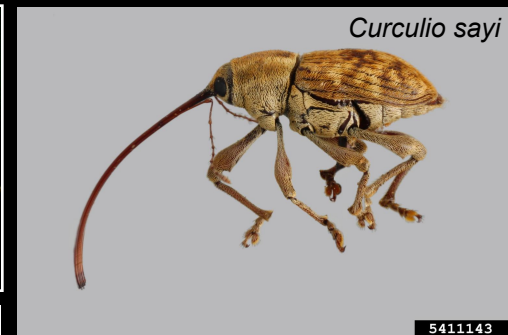
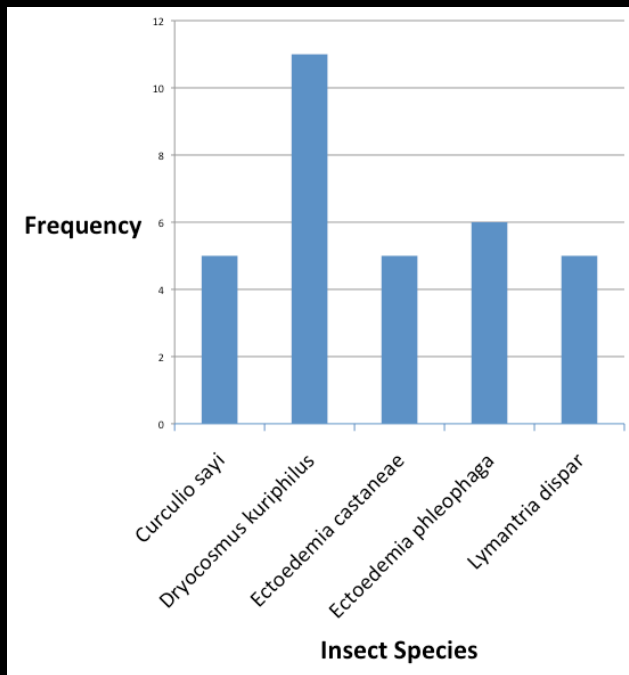
- How did functional extinction of Amc impact insects associated with Amc?
- How similar was/is insect fauna between Amc & related tree species (e.g., oaks) before & after blight?
- To what extent might related tree species source herbivorous insects recolonizing blight-resistant Amc?
- Will herbivorous insects be in enemy free space?



American Chestnut & Associated Insects

Herbivorous insects on Amc & their parasitoids

- insect fauna on Amc prior to blight largely unknown
- exhaustive literature search yielded 259 reported occurrences of insects on Amc consisting of 157 species



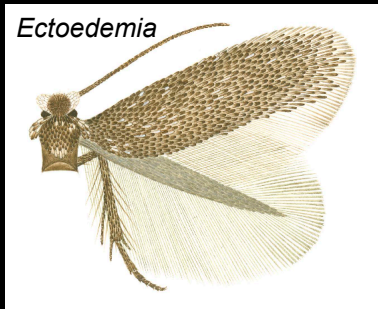
-5 most frequently encountered species

American Chestnut & Associated Insects

Herbivorous insects on Amc & their parasitoids

- ecological extinction of Amc resulted in concomitant extinction of four moth species that used Amc

- one of largest documented invertebrate extinctions (4 of 41 extinctions)



Nepticulidae

Ectoedemia castaneae

Ectoedemia phleophaga

Tischeriidae

Coptotriche perplexa

Yponomeutidae

Argyresthia castanella

American Chestnut & Associated Insects

Herbivorous insects on Amc & their parasitoids

- 46% of occurrences in literature are from two publications

Opler (1978): survey of leaf-feeding moths on Amc in Fairfax Co., VA

55 species feed on Amc

-7 on Amc only; 13 on *Castanea* spp.

-7 Amc preferred host plant

-6 extinct; 2 subsequently recovered



American Chestnut & Associated Insects

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Russin (1984): survey of insects associated with Amc stems & cankers in Menifee Co., KY

-495 morphospecies collected using sticky traps on Amc

-only identified insects that potentially vector fungus; 35 species (94% Coleoptera)



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- lack of baseline data for insects on Amc prior to blight hinders research on how loss of Amc affected insect populations (e.g., extinction, population decline, host plant shifts)



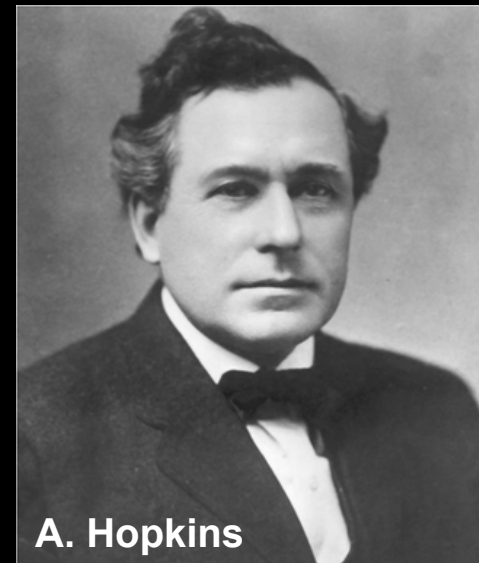
American Chestnut & Associated Insects

Uncovering historical trophic structure for insects associated with Amc

- Andrew Delmar Hopkins

- Hopkins Notes and Records System

- contains records of insects on plants in U.S., including >1,000 for Amc***



A. Hopkins

- most voucher specimens for these records are at USNM & are labeled with numbers associating them to cards

- records span from 1899 to 1980s: opportunity to document insects associated with Amc before & after blight***

Insects Associated Amc - Materials & Methods

- Where are Amc records amongst ~200,000 cards?

- divided card holdings into 10 sections; randomly searched each section for records of insects on Amc

- scanned cards documenting insect occurrence on Amc

- assessed which sections yielded most records

- Exhaustive search

- searched every card for most productive sections; scanned cards documenting insect occurrence on Amc



Insects Associated Amc - Materials & Methods

- data on cards interpreted & entered into spreadsheet
 - location, collection date, insect taxon, stage collected, emergence date (immature hosts, parasitoids), host (plant part, insect taxon), & natural history information

HOPK. U. S.
1962 Tryon N.C. Apr 9 1963 Chestnut

a Cerambycid larva = *Leptocryptus*
- b Parasitic wasp (Ichneumonid) see c
- c Pupae & adults cerambycid.
d Parasitoid of = *Helcon*^{sp. n.} *castaneae* nsp. bin
- e Cerambycid pupa
f do
g Larvae beneath bark

1462^a BUREAU OF ENTOMOLOGY, FOREST INSECTS.
HOPK. U. S. *Helconidea castaneae* (Vier) ~~SAK~~

Chestnut
Tryon, N.C.
April 1963

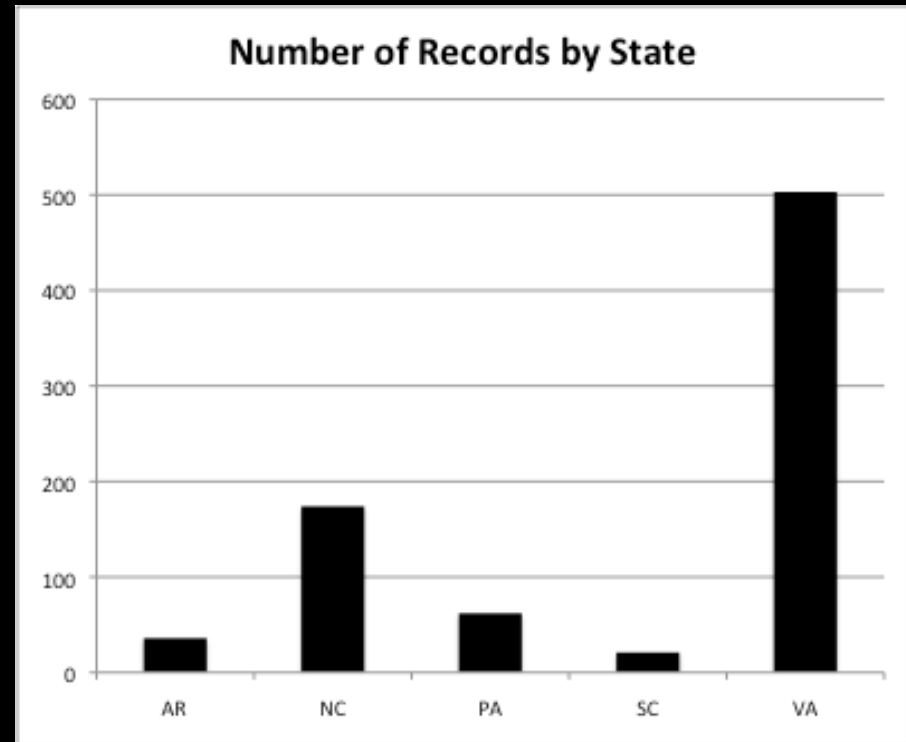
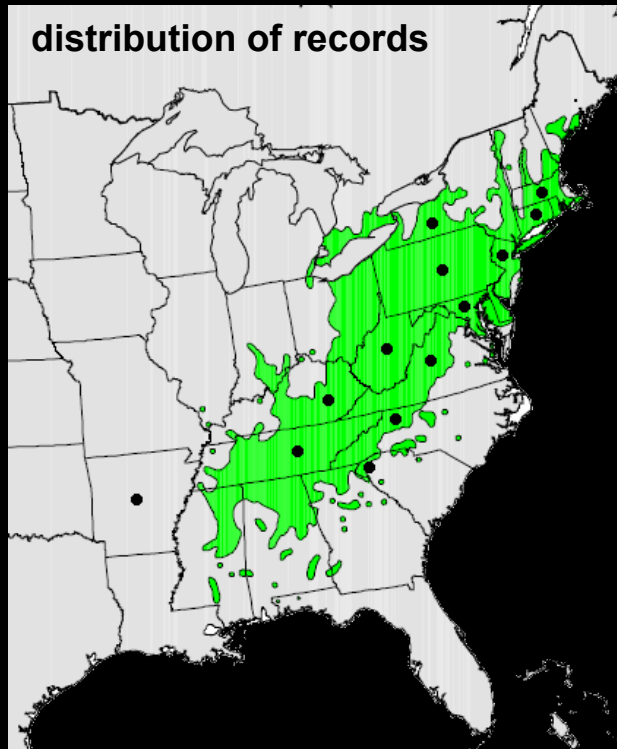
Parasitoid of Cerambycid larvae 1462^a

8-1738

- data on occurrence of insects on Amc taken from literature & entered into spreadsheet
 - basis for determining extent of novel data in cards

Insects Associated Amc - Results

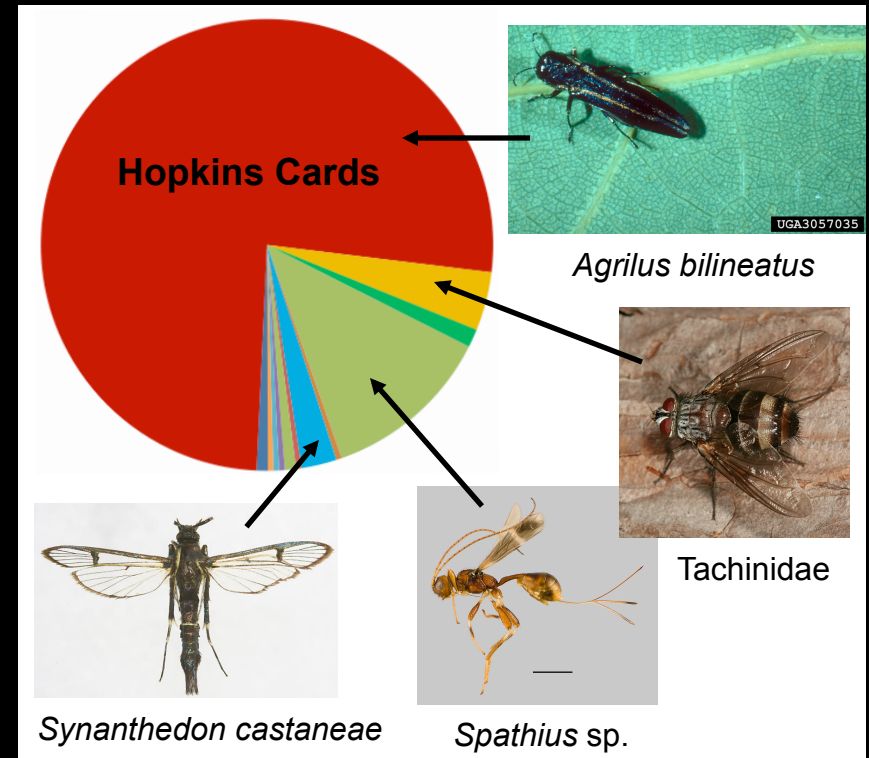
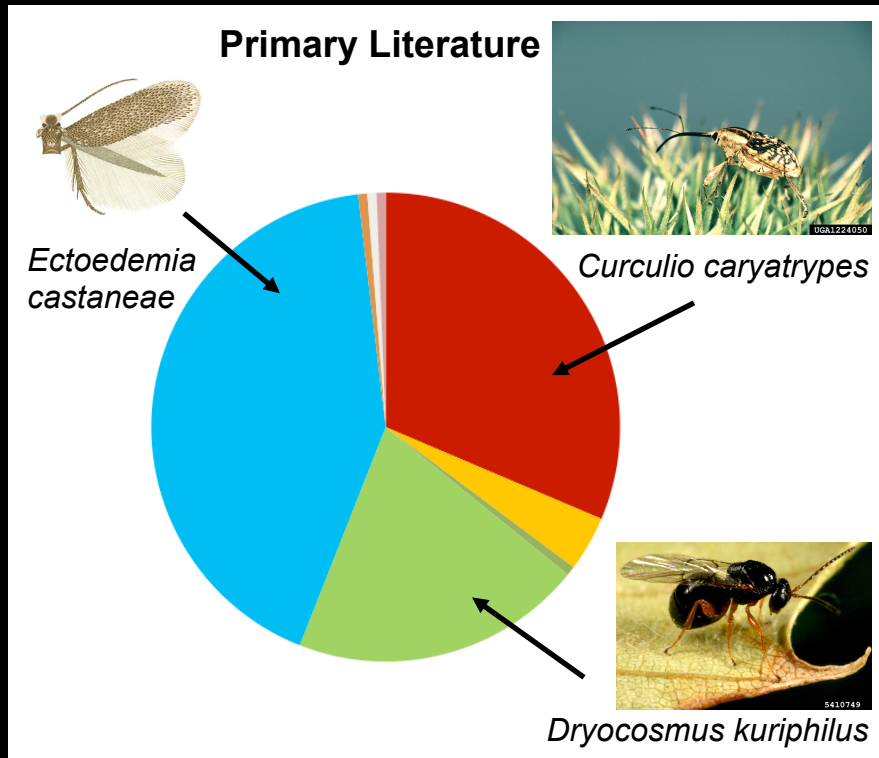
- tens of thousands of cards scanned; 874* records of individual insects from 14 states (*currently 1,049 records)



- maximum of 16 records of individual insects in other states

Insects Associated Amc - Results

- Results from cards compared with primary literature



Blattaria	Hymenoptera	Orthoptera
Coleoptera	Isoptera	Phasmida
Diptera	Lepidoptera	Prostigmata
Hemiptera	Neuroptera	Trombidiformes

-literature: Opler (1978) & Russin (1984); gall wasp

-Hopkins: wood-borers & their parasitoids

Insects Associated Amc - Results

- 221 insect species associated with chestnut

- wood-borers, foliage- & nut-feeders, scavengers, detritivores, fungivores, predators, & parasitoids

- 29 wasp-host associations; 7 new associations discovered thus far

Ectoedemia castanea
Falls Church VA, 1912



Mirax ectoedemiae

Ectoedemia phleophaga
Falls Church VA, 1913



Adelius fasciipennis

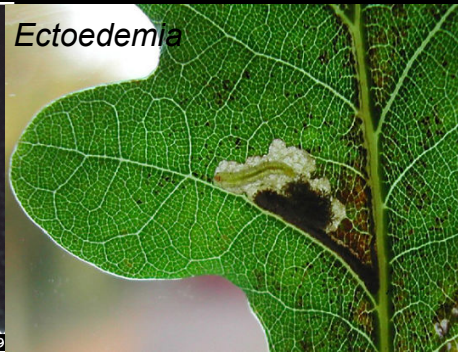
Ectoedemia phleophaga
Falls Church VA, 1913



Dirrhope americana

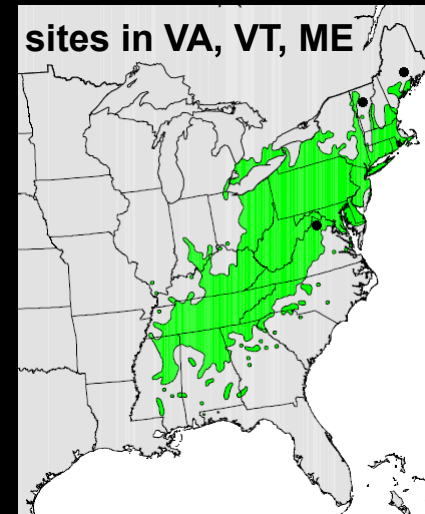
Insects Associated Amc - Contemporary Collections

- focus on insects that feed on living Amc tissue & their parasitoids



Insects Associated Amc - Materials & Methods

- canopy trapping for insects associated with chestnut & oak
- 1 trap each placed in 3 Amc, Chinese chestnut, & red oak trees
- compare herbivore & parasitoid diversity among tree species
- traps operated May-November at 2 sites in northern VA
- 1 trap each in 2 Amc & red oaks in ME; 1 trap in Amc in VT in June
- samples collected every 2 weeks



Insects Associated Amc - Materials & Methods

- specimens pulled; non-hyms to collaborators

-Buprestidae, Cerambycidae,
Chrysomelidae, Curculionoidea

-Neuroptera

-Hemiptera -Tachinidae

-Lepidoptera (larvae)

-Hymenoptera (except Aculeata)

- microhymns HMDS
dehydrated, mounted on
points or cards, & labeled

- identified using keys, diagnoses,
& previously determined
specimens (USNM)



Insects Associated Amc - Results

- 272 samples collected (2014-2015); 120 sorted (44%)

- Highest to lowest abundance

Coleoptera – *New genus*

Hemiptera

(Auch. & Stern.)

Hymenoptera

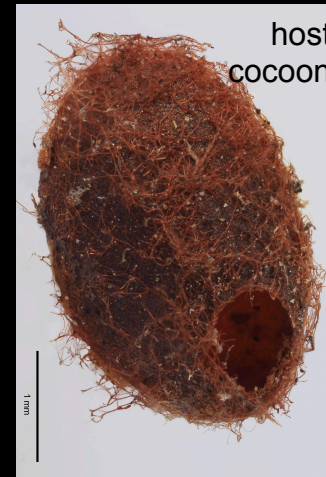
calyptrate flies

Neuroptera

Lepidoptera

(larvae only)

>2,000 braconid specimens (18 subfamilies) dehydrated, mounted, & labeled



-Dirrhope americana ex E. phleophaga!



-Caliroa lorata ex Castanea dentata

Insects Associated Amc - Future Directions

- obtain herbivore-natural enemy associations via Hopkins cards
- process samples & specimens from canopy traps
- rear parasitoids to discern host-parasitoid associations on chestnut & red oak (mid-Atlantic)
- focus on Lepidoptera; inspect foliage, beating sheet
- sentinel larvae placed on foliage
- pre- & postblight food webs for Amc & red oak
- website on ID & biology of Amc herbivores & their natural enemies



Acknowledgments

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TACF

- Jack LaMonica (VA Chapter)
- Kendra Gurney (VT Chapter)



