Spotted Lanternfly: an invasive on the horizon

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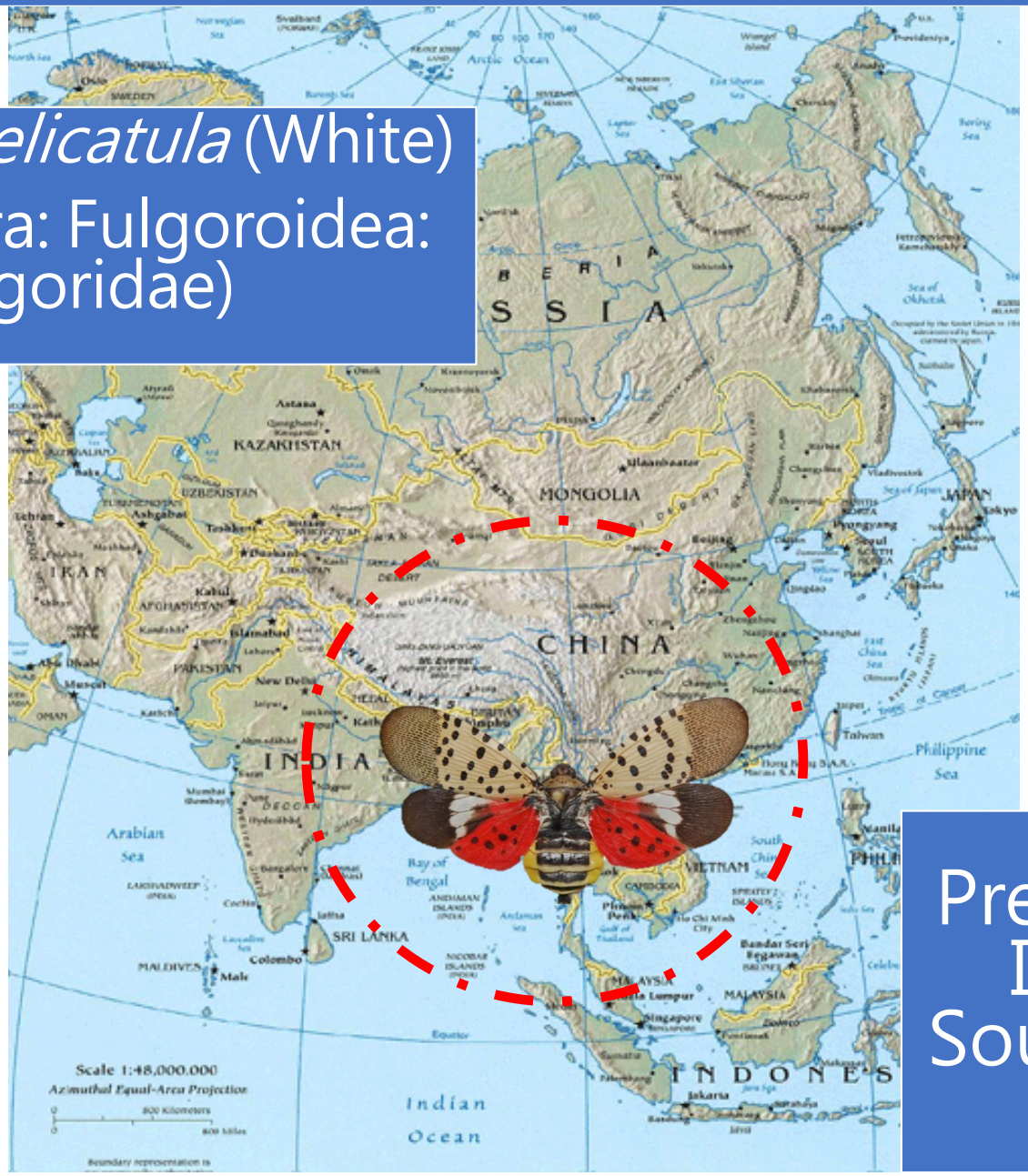
USDA

SLF is an Invasive Species in the USA

Lycorma delicatula (White)
(Hemiptera: Fulgoroidea: Fulgoridae)



Present in China, India, Japan, South Korea, and Vietnam

SLF first detection and quarantine

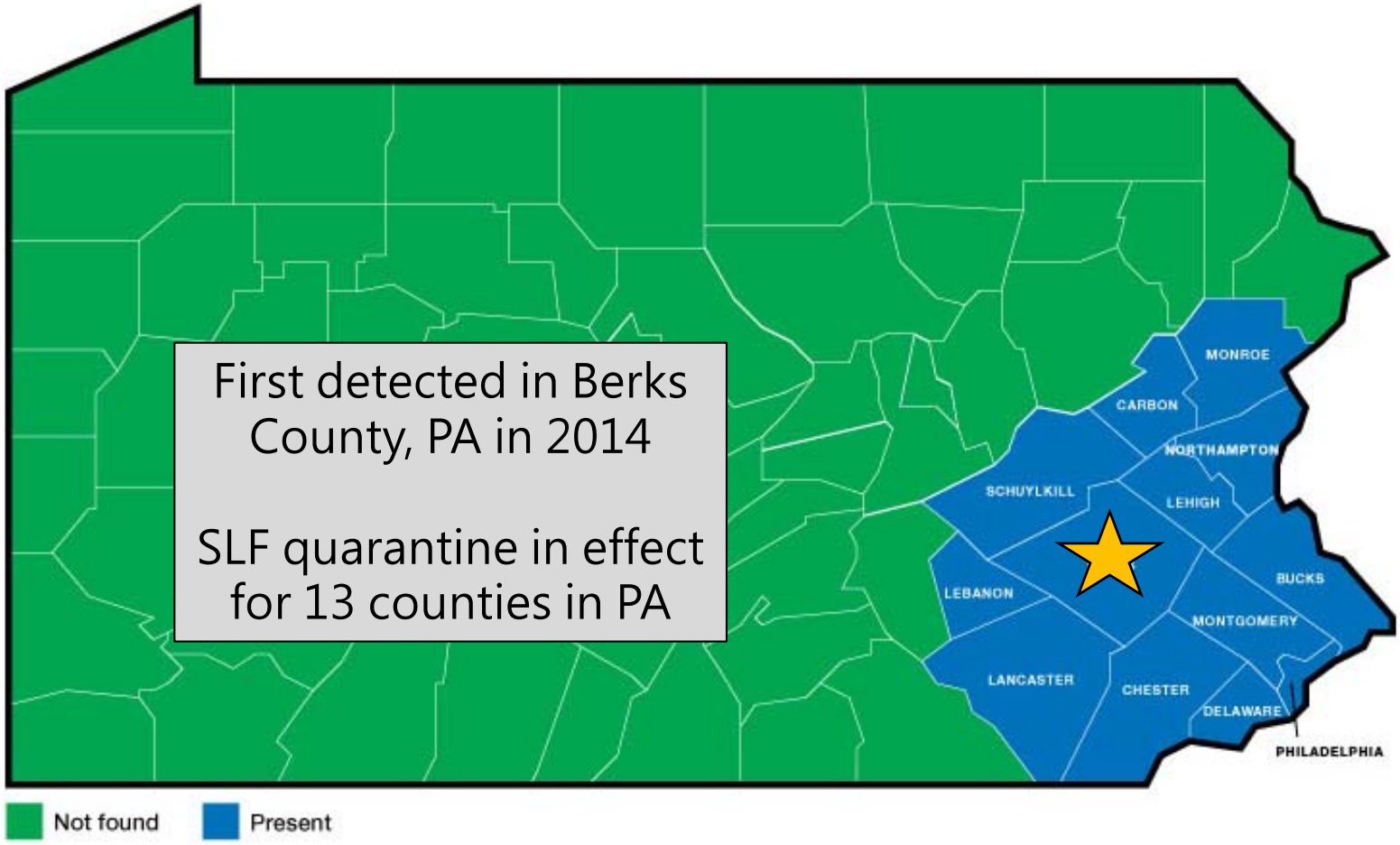
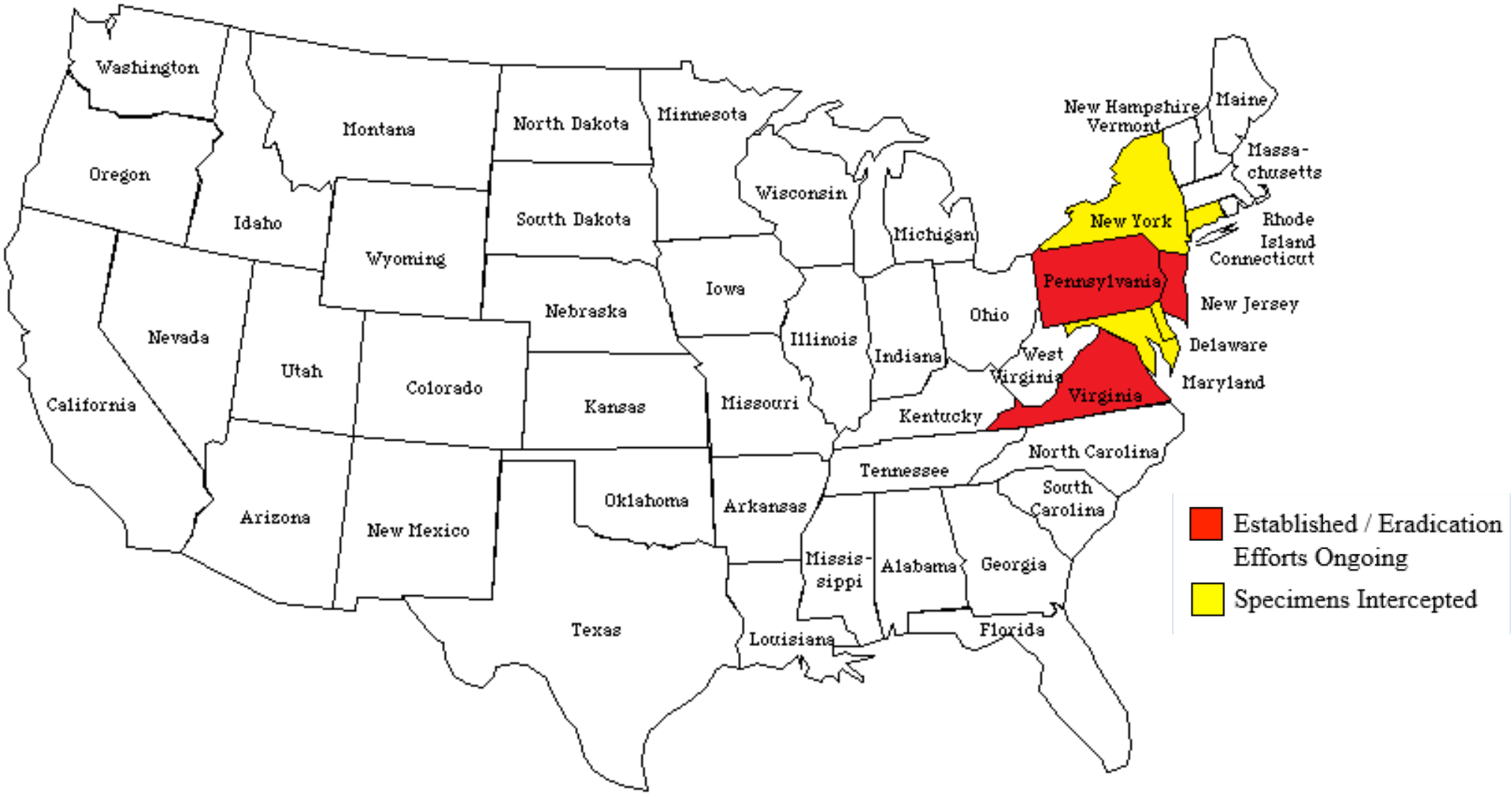


Figure 2. The distribution as of September 20, 2018, of SLF in Pennsylvania, indicated in blue. Check the Pennsylvania Department of Agriculture's website for updated distribution information.

Current Distribution of SLF in the USA



Established populations in Pennsylvania, New Jersey and Virginia

Specimens Intercepted in New York, Delaware, Maryland and Connecticut

SPOTTED LANTERNFLY LIFE CYCLE

EGGS
October — June

HATCH AND FIRST INSTAR
May — June

SECOND INSTAR
June — July

THIRD INSTAR
June — July

FOURTH INSTAR
July — September

ADULTS
July — December

EGG LAYING
September — December

Illustrations by Colleen Witkowski

How to Identify the Invasive SLF

E. Swackhamer

PA Department of Agriculture

PA Department of Agriculture

PA Department of Agriculture

PA Department of Agriculture

A. Egg masses

B. Early nymph

C. Late nymph

D. Adult, wings closed

E. Adult, wings open

SLF eggs

Photo: H. Leach, PSU

Nymphal Stages of SLF

Photo: Dalton Ludwick

Photo: PA Dept. of Agriculture

- Early stage nymphs (1st–3rd instars) have black bodies and legs with white spots
- Only a few centimeters long
- Strong jumpers; will jump when frightened
- Tend to feed on the new growth of a plant, such as stems and foliage

Nymphal Stages of SLF


Photo: Dalton Ludwick


Photo: Steve Ausmus

- Late stage nymphs (4th instars) have bright red bodies with black stripes and white spots
- Last nymphal stage before becoming adults
- About ½ inch long
- Strong jumpers; will jump when frightened

Adult SLF

Photo: Mike Houtz

- Adults are about 1” long
- Females tend to be slightly larger than the males

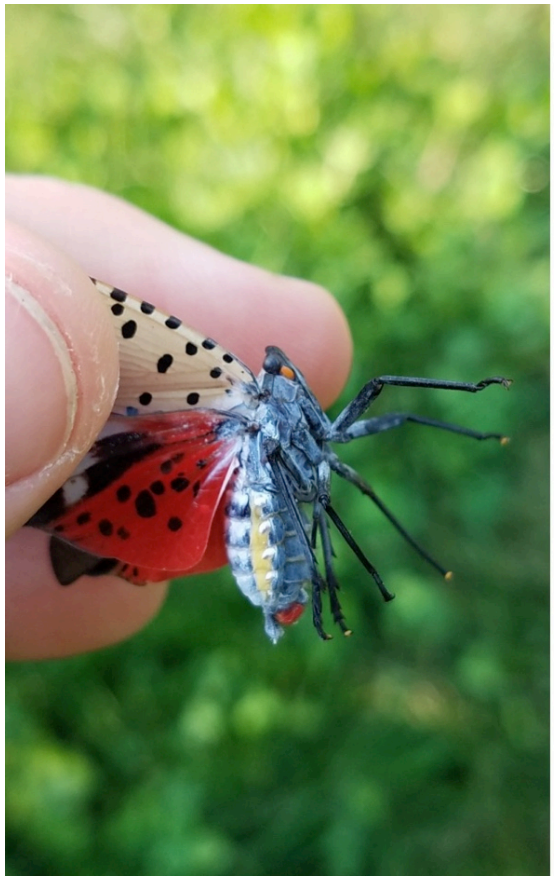
Adult SLF

Group of adult SLF feeding at the base of a tree

Adult SLF Feeding on Grapevine

Video: Erica Smyers, PSU

Adult SLF



- Early season (left) vs. late season (right) female SLF
  - Females build up fat bodies towards end of summer to prepare for egg laying

Potential to Cause Economic Damage

- **Direct effects**
  - Phloem feeders; reported to feed on over 65 species of plants
  - Knowledge gaps in host range in the US
  - Projected to become a serious pest of timber, ornamental trees, tree fruit, stone fruit, grapes, hops and small fruit such as blueberries
  - Feeding could potentially shock trees and cause decline

Potential to Cause Economic Damage

- **Indirect effects of feeding**
  - Excrete large amounts of honeydew while feeding
  - Sooty mold outbreak on the leaves and fruit
  - May exacerbate yellow jacket problems

Photo: H. Leach, PSU

Photo: H. Leach, PSU

Host plants	Family	Korean name	Stage	Degree of damage[1]
Actinidai chinensis	Actinidiaceae	양다래	nymph	+++
Rhus javanica	Anacardiaceae	붉나무	nymph	+++
Rhus verniciflua	Anacardiaceae	옻나무	nymph	++
Aralia elata	Araliaceae	두릅나무	nymph	+++
Aralia cordata	Araliaceae	땃두릅나무	nymph	+++
Metaplexis japonica	Asclepiadaceae	박주가리	nymph	+
Alnus hirsuta	Betulaceae	산오리나무	nymph	+
Betula platyphylla	Betulaceae	자작나무	adult	+++
Arctium lappa	Compositae	우엉	nymph	++
Quercus aliena	Fagaceae	갈참나무	nymph	++
Juglans mandshurica	Juglandaceae	가래나무	adult, nymph	++++
Juglans nigra	Juglandaceae	흑호두나무	nymph	++
Juglans sinensis	Juglandaceae	호두나무	nymph	+
Pterocarya stenoptera	Juglandaceae	중국굴피나무	nymph	+
Maackia amurensis	Leguminosae	다릅나무	nymph	+
Magnolia obovata	Magnoliaceae	일본목련	nymph	++
Magnolia kobus	Magnoliaceae	목련	nymph	+
Cedrela fissilis	Meliaceae	유럽참죽나무	adult, nymph	++++
Toona sinensis	Meliaceae	참죽나무	adult, nymph	++++
Toona sinensis 'Flamingo'	Meliaceae	호주참죽나무	adult, nymph	++++
Morus alba	Moraceae	뽕나무	nymph	++
Morus bombycis	Moraceae	산뽕나무	nymph	++
Rosa hybrida	Rosaceae	장미	nymph	+
Rosa multiflora	Rosaceae	찔레나무	nymph	++
Rosa rugosa	Rosaceae	해당화	nymph	++
Rubus crataegifolius	Rosaceae	산딸기나무	nymph	++
Sorbus commixta	Rosaceae	마가목	nymph	+
Sorbaria sorbifolia	Rosaceae	쉬땅나무	nymph	++
Evodia daniellii	Rutaceae	쉬나무	adult, nymph	++++
Phellodendron amurense	Rutaceae	황벽나무	adult, nymph	++++
Populus koreana	Salicaceae	물황철나무	adult	++
Philadelphus schrenckii	Saxifragaceae	고광나무	nymph	++
Picrasma quassioides	Simaroubaceae	소태나무	adult, nymph	++++
Ailanthus altissima	Simaroubaceae	가죽나무	adult, nymph	++++
Firmiana simplex	Sterculiaceae	벽오동	nymph	++
Styrax obassia	Styracaceae	쪽동백나무	nymph	+
Styrax japonica	Styracaceae	때죽나무	adult, nymph	++
Angelica dahurica	Umbelliferae	구릿대	nymph	+
Parthenocissus quinquefolia	Vitaceae	미국담쟁이덩굴	adult, nymph	++++
Vitis amurensis	Vitaceae	머루	adult, nymph	++++
Vitis vinifera	Vitaceae	포도	adult, nymph	++++

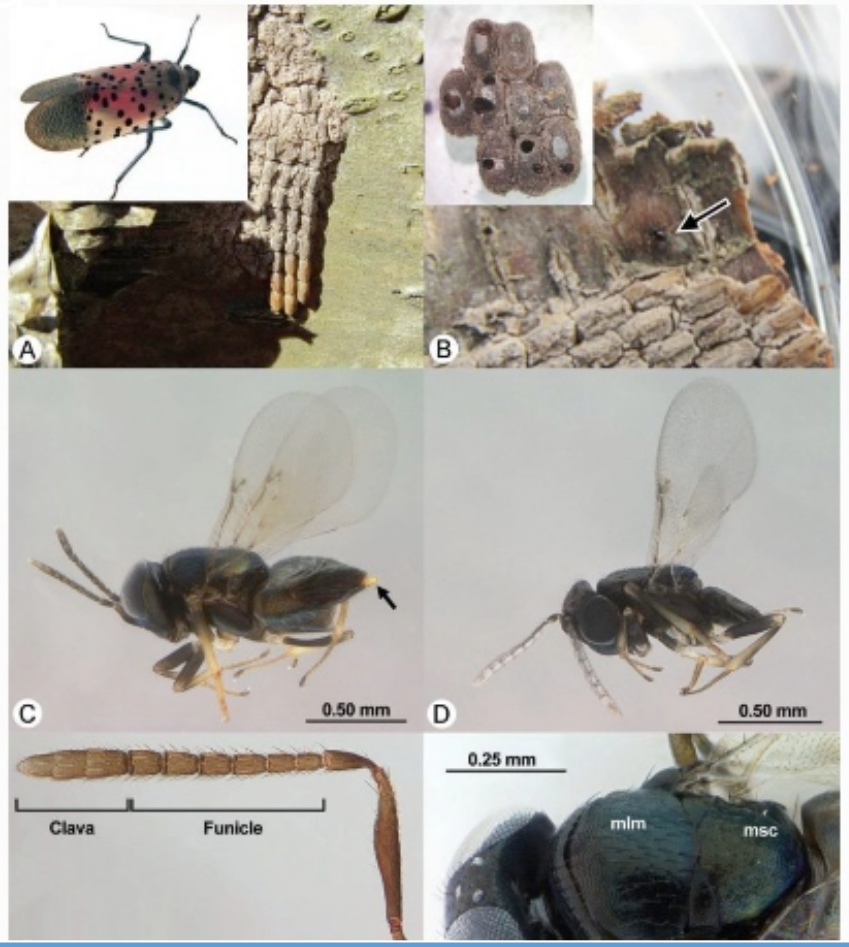
[1]Degree of damage; ++++: very serious, +++: serious, ++: middle, +: weak

Host list from researchers in South Korea

- Includes:
  - Grape
  - Walnut and birch
  - Rosaceous plants
- Don't have a good handle on the impacts on tree fruit
- Future host plant studies planned

Potential Biological Control Agents

Anastatus orientalis



Ooencyrtus kuvana

Present in North America

Introduced for biological control of gypsy moth

Has been recovered from eggs in PA

What don't we know?

- We have very little information on their biology, ecology and behavior
- We have no monitoring tools for this species in any cropping system
- What is the host range? Is tree of heaven an obligatory host? Must they feed on this species in order to complete their nymphal development or for adults to reproduce?
- Do SLF feed on apple? What impact will their feeding on have on young trees/vines and on developing fruit buds? Do they transmit diseases?
- What are best materials for managing adults and nymphs?
- Biological control?


Ongoing Research Efforts:
proof of concept for future studies
• Trapping study
• eDNA study
• Gut content analysis

Preliminary Trapping Study

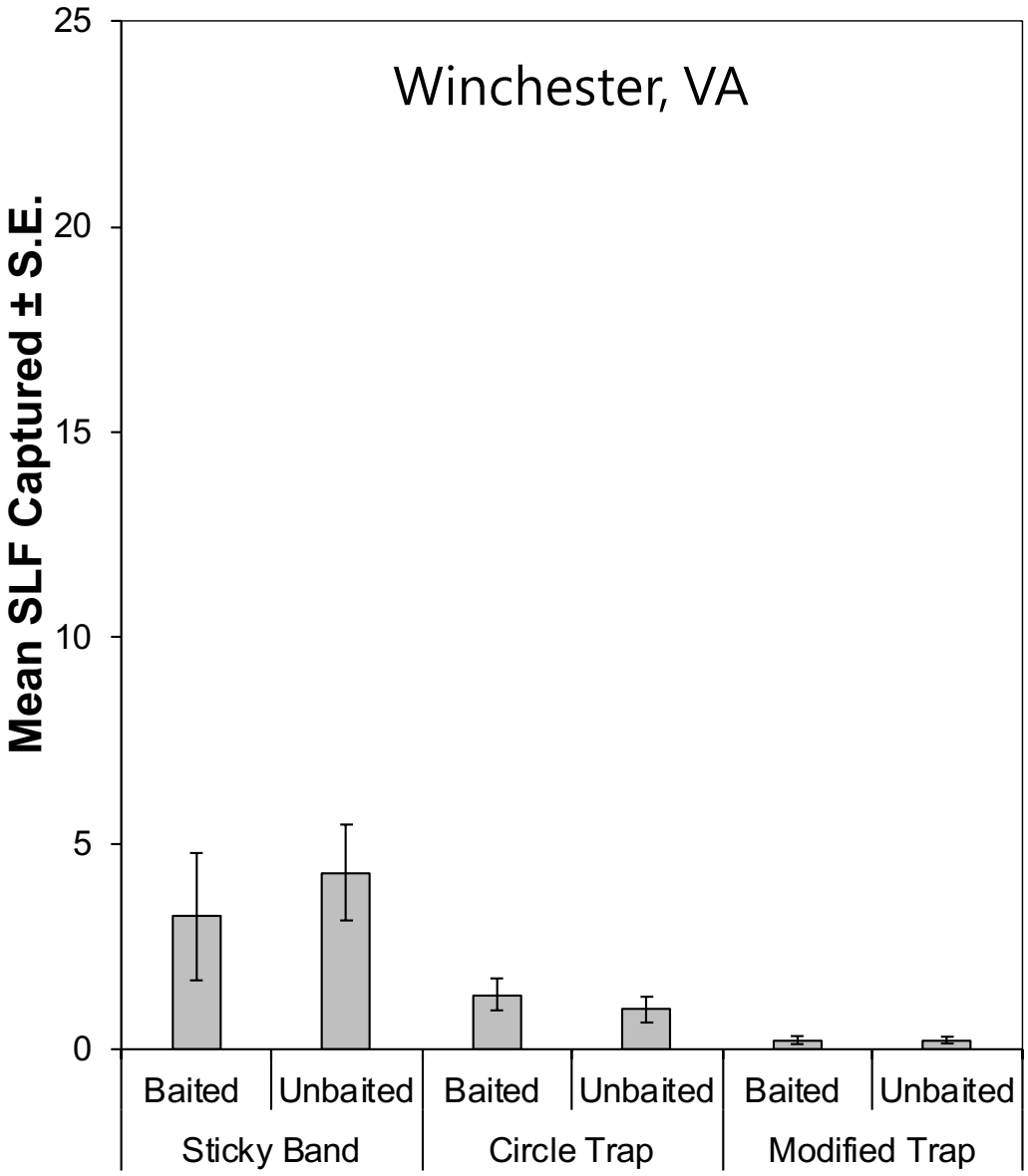
Sticky Band Trap

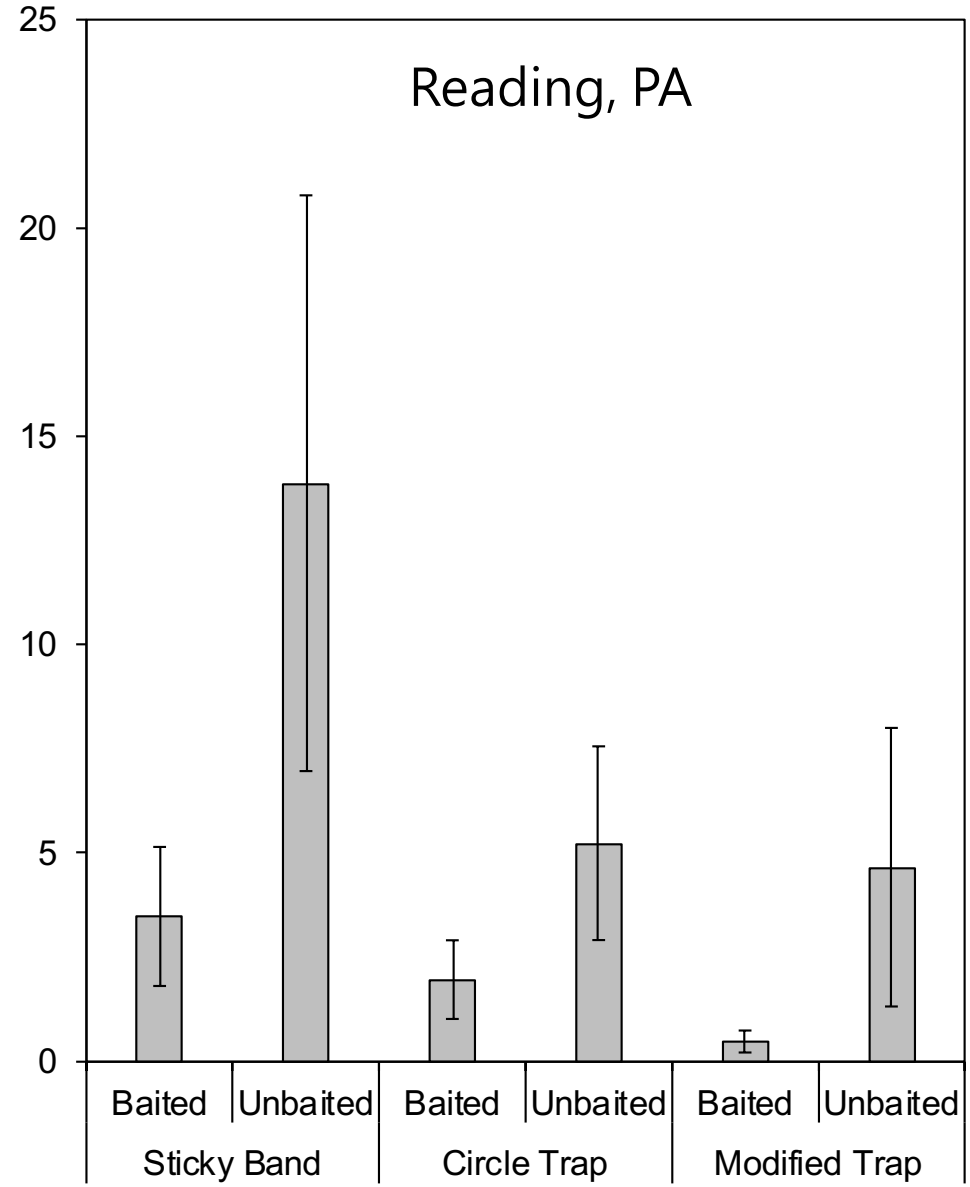
Modified Trap

- 2 sites – Winchester, VA (lower population) and Reading, PA (higher population density)
- 3 trap types, baited and unbaited
- Traps checked weekly and captures recorded
- Sticky bands and lures replaced weekly

Circle Trap

Trapping Study Results





Sticky band traps: effective for capturing nymphs and adults throughout season



Non-target captures of vertebrates and invertebrates on sticky bands: a potential problem

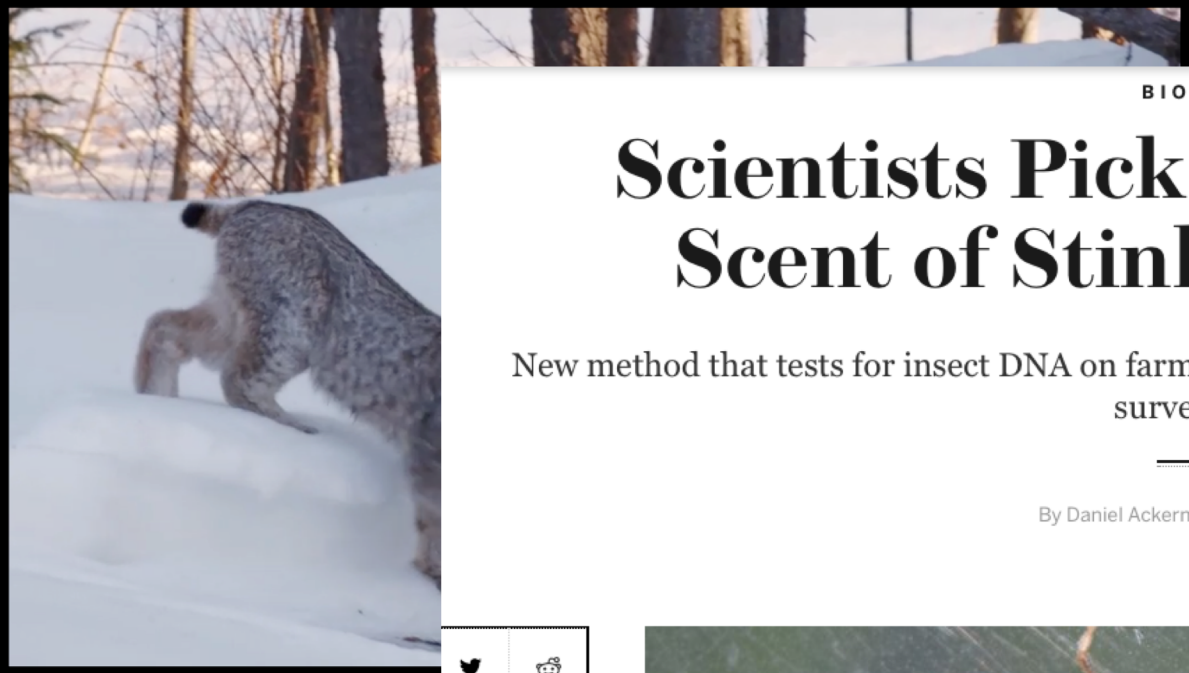
Better options moving forward?

Photo: H. Leach, PSU

ANIMALS | VIDEO

How DNA from snow helps scientists track elusive animals

Researchers are using environmental DNA to help monitor and measure populations of rare snow-dwelling species like Canadian lynx.



BIOLOGY

Scientists Pick Up the Genetic Scent of Stinkbug Invaders

New method that tests for insect DNA on farm produce could "revolutionize" agricultural pest surveillance

By Daniel Ackerman on July 12, 2018

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bugs, America. B
won't be man-fac

Tick Discovery Hi
How Few Answer
about These Pest

eDNA Collection Methods:

1. Aggregate target DNA using water
2. Isolate eDNA using qPCR
3. Compare against database of known DNA sequences to identify the organism that left it behind

Preliminary eDNA Results

Week 1	Site 1	Site 2	Site 3
Apple			x
Grape			x
Peach	x		
Tree of Heaven			x
Walnut			x

Week 2	Site 1	Site 2	Site 3
Apple			
Grape		x	
Peach			x
Tree of Heaven	x	x	
Walnut	x		x

Week 3	Site 1	Site 2	Site 3
Apple			
Grape			
Peach	x		
Tree of Heaven			
Walnut			

x	Positive SLF eDNA detection
	Negative SLF eDNA detection
	No sample collected

Gut Content Analysis Methods

Gut Content Analysis of a Phloem-Feeding Insect, *Bactericera cockerelli* (Hemiptera: Triozidae) FREE

W. Rodney Cooper ✉, David R. Horton, Thomas R. Unruh, Stephen F. Garczynski

Environmental Entomology, Volume 45, Issue 4, 1 August 2016, Pages 938–944,
https://doi.org/10.1093/ee/nvw060
Published: 06 June 2016 **Article history** ▾

- Plant DNA can be detected in phloem-feeding insects
- PCR-based methods to identify what plant species had previously been fed upon
- Gut content analysis is extremely sensitive to even the smallest amount of DNA

- Previous studies used whole insects; due to large size of SLF have to dissect out the guts for analysis
- Able to see visible amplicons using ITS
- Able to get a number of plant sequences from SLF specimens

Gut Content Analysis Preliminary Results

Plant	Identity	Sequences
Portulaca sp. (Purslane?)	99.7% pairwise identity	4/19 sequences
Solanum spp. (Nightshade plants)	95.7% identity	2/19
Ailanthus altissima (Tree of Heaven)	99.5% identity	1/19 sequences
Medicago spp. (Alfalfa?)	100% identity	1/19 sequences

- Able to see visible amplicons using ITS
- Able to get a number of plant sequences from SLF specimens
- Need dedicated dissection area for SLF to prevent contamination
- Future studies can help narrow down host range

Conclusions and Future Directions

- **Adults and nymphs** can be trapped
  - Evaluate trap designs
  - Effective lure
  - Limit non-target captures
- **eDNA** is an effective **tool** that can be used for SLF to detect adventive populations
- **Gut content analysis studies** can help identify host range
- Future studies will build on the preliminary data collected to help fill current knowledge gaps
- Quarantine lab space at Fort Detrick

Acknowledgements

- Leskey Lab
- Demian Nunez
- Layne Leake
- Dalton Ludwick
- Laura Nixon
- Aya Ibrahim
- Heather Leach, PSU Extension
- Julie Urban, PSU
- Mark Sutphin, VT Extension
- Anne Nielsen, Rutgers Univ
- Julie Lockwood, Rutgers Univ
- Dina Fonseca, Rutgers Univ
- Rafael Valentin, Rutgers Univ
- Rodney Cooper, USDA-ARS