Attack of Trissolcus japonicus and native parasitoids on BMSB and nontarget egg masses in MD, DC, VA, WV, and DE.

T. euschisti photo by Elijah Talamas

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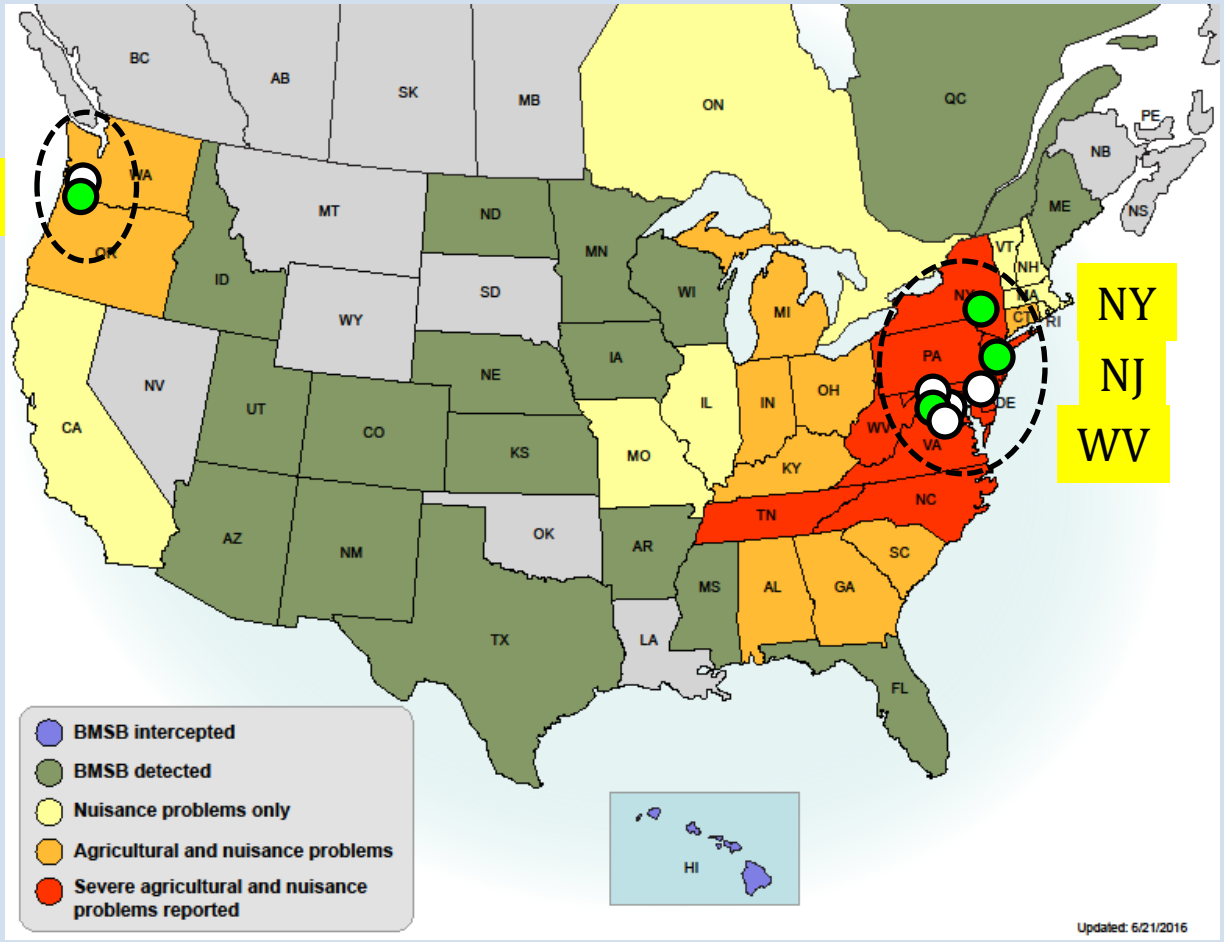
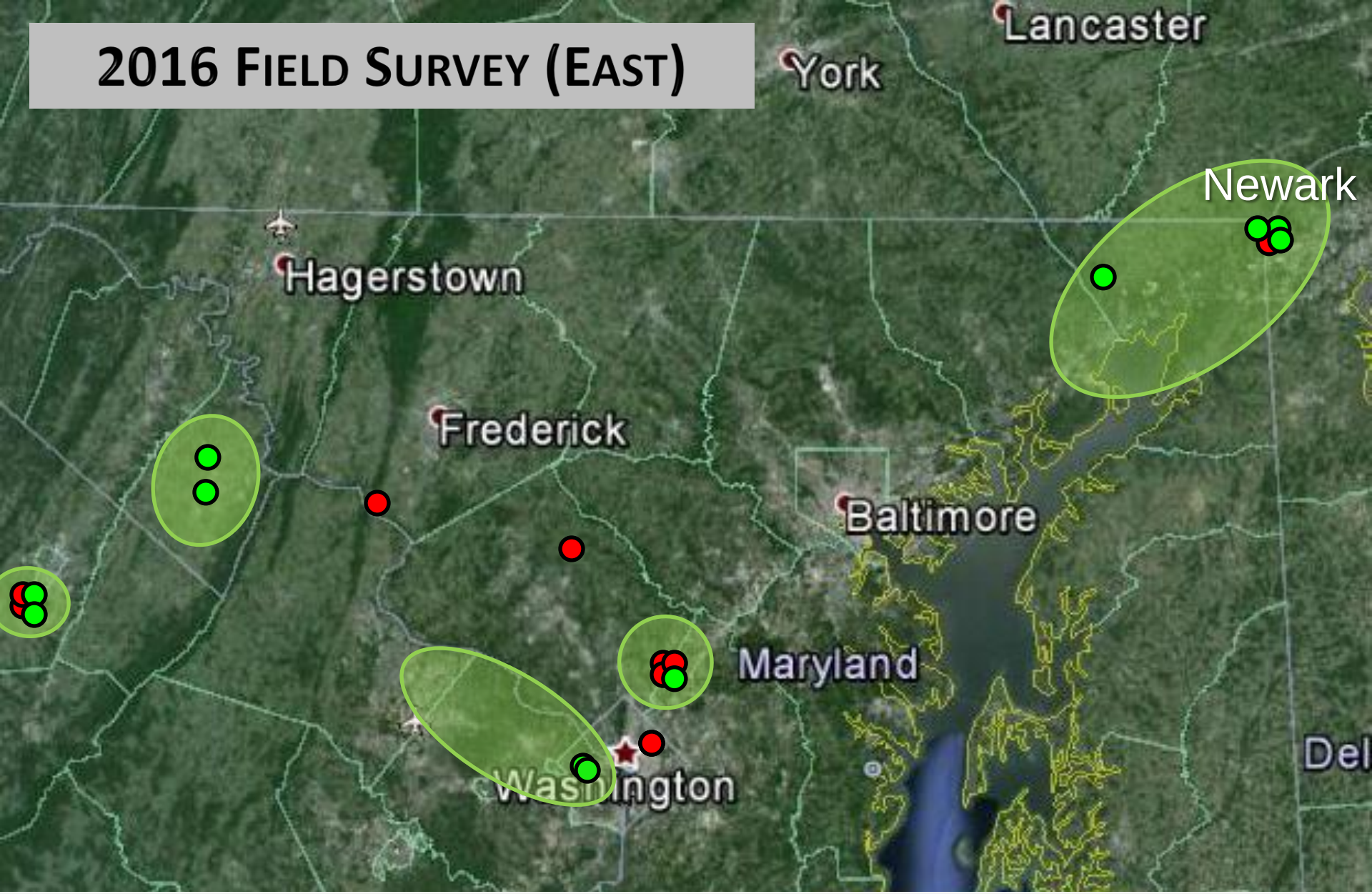
Questions

1. What is the current distribution of *T. japonicus*?
2. What are the habitat preferences of *T. japonicus* as well as native parasitoids?
3. To what extent does *T. japonicus* parasitize native beneficial stinkbugs (e.g. *Podisus maculiventris*) ?
4. What is the attack and success rate of parasitism of BMSB by native parasitoids?

U.S. field recoveries of *Trissolcus japonicus* (as of Nov. 2016)



New states in 2016



***T. japonicus* now in: MD, DC, VA, WV, DE, NJ, NY (East) & OR, WA (West)**

2016 Recoveries were all from BMSB (sentinel & wild) **previous** **new in 2016**

Maryland Methods:
3 Habitat types

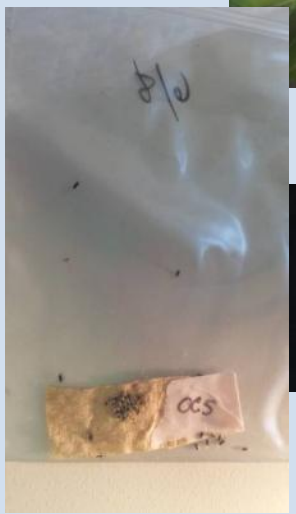
- Field crop (soybean)
- Orchard (apple) or scattered trees
- Woods (various native and invasive vegetation)

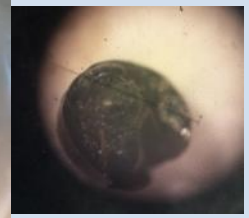
Maryland Methods: 3 Egg mass Treatments

- ≤24-hour-old BMSB eggs
- ≤24-hour-old BMSB eggs frozen at -80°C for 2 min.
- ≤24-hour-old *Podisus maculiventris* eggs
- Eggs laid by adults in mesh cages around tree branches

Methods: Experimental design

- Fresh and frozen sentinel eggs laid on paper towels by colony insects were pinned to various vegetation at each site and were exposed for 72 hrs.
- All egg masses returned to lab and reared out in a growth chamber (16L:8D, 25°C) until either a stinkbug nymph or a parasitoid emerged
- If nothing emerged, eggs were dissected and unemerged parasitoids identified.
- Eggs collected from cages 2x/week.





Overview of Results

	2015		2016	
# eggs deployed (all types)	42,177		15,774	
# eggs recovered (all types)	26,694		11,276	
% predation	36.7 %		28.5 %	
% pupae	5%		3%	
Parasitism	**% Successful (#)**	**% Stuck (#)**	**% Successful (#)**	**% Stuck (#)**
Anastatus reduvii	**1.4 %** (388)	**0.1%** (36)	**2.0 %** (231)	**0.2%** (18)
Trissolcus japonicus	**1.0 %** (274)	**0.03%** (9)	**0.2 %** (23)	--
Tr. euschisti	**3.9 %** (1050)	**0.5%** (123)	**2.1 %** (241)	**0.1%** (15)
Tr. brochymenae	**1.9 %** (510)	**0.5%** (127)	**0.3%** (30)	--
Tr. edessae	**0.6 %** (161)	**0.08%** (22)	**0.3%** (32)	--
Telonomus podisi	**0.7 %** (199)	**2.1 %** (572)	**0.4%** (40)	**1.3 %** (144)
Ooencyrtus johnsoni	**0.9 %** (242)	**0.05%** (13)	**0.3%** (31)	**0.2%** (21)
TOTAL % parasitized	**10.6 %** (2775)	**3.6 %** (975)	**5.6 %** (628)	**1.8 %** (198)

Results: Predation

	# of eggs predated	Total number of eggs recovered	Total % predated	Chewing predation	Sucking predation
P. maculiventris	1,495	3,480	43%	94%	6%
Fresh BMSB	927	3,756	25%	96%	4%
Frozen BMSB	816	4,040	20%	99%	1%
total	3238	11276	29%	96%	4%

Results by egg type

	eggs recovered	**% emerged parasitoids**	% *Trissolcus japonicus* LIVE	% *Trissolcus* native spp. LIVE	% *Telenomus podisi* LIVE	% *Anastatus* LIVE	% Other, ALIVE	**% dead parasitoids**	% *Trissolcus japonicus* DEAD	% *Trissolcus* native spp. DEAD	% *Telenomus podisi* DEAD	% *Anastatus* DEAD	% Other, DEAD
BMSB Frozen	**4,040**	**8.7%**	0%	5.1%	0.1%	3%	0.4%	**1.6%**	0%	0.2%	1%	0.3%	0.1%
BMSB Fresh	**3,756**	**3%**	0.6%	0.1%	0.03%	2.3%	0.2%	**0.5%**	0%	0.03%	0.13%	0.13%	0.2%
***Podisus* Fresh**	**3,480**	**4%**	0%	2.6%	0.9%	0.5%	0.2%	**3.3%**	0%	0.17%	3%	0%	0.2%

Results by habitat

	eggs recovered	**% emerged parasitoids**	% *Trissolcus japonicus* LIVE	% *Trissolcus* native spp. LIVE	% *Telenomus podisi* LIVE	% *Anastatus* LIVE	% Other, ALIVE	**% dead parasitoids**	% *Trissolcus japonicus* DEAD	% *Trissolcus* native spp. DEAD	% *Telenomus podisi* DEAD	% *Anastatus* DEAD	% Other, DEAD
Orchard	**5,169**	**5.7%**	0.4%	2.2%	0.15%	2.9%	0%	**0.9%**	0%	0.14%	0.44%	0.31%	0%
Soy	**872**	**3%**	0%	0%	3%	0%	0%	**10.2%**	0%	0%	10.2%	0%	0%
Woods	**5,235**	**5.8%**	0%	3.5%	0.15%	1.6%	0.6%	**1.2%**	0%	0.15%	0.63%	0.04%	0.4%

Results by parasitoid species

	2015		2016	
	% of parasitized	% of parasitoid adults stuck inside eggs	% of parasitized	% of parasitoid adults stuck inside eggs
A. reduvii	11%	8%	30%	7%
T. japonicus	7.5%	3%	3%	0%
T. euschisti	31%	10%	31%	6%
T. brochymenae	9%	20%	4%	0%
T. edessae	5%	12%	4%	0%
Te. podisi	21%	75%	22%	78%
Encyrtid	7%	5%	6%	40%

Results: *Trissolcus japonicus*

- **Only 1 egg mass at the BARC sites and 2 in Arlington, VA. (total of 45 eggs) Compared with 18 egg masses (total of 320 eggs) in 2015**
- **High rate of successful emergence (91%) in all egg mass types**
- **Habitats: All found on wooded edges and scattered tree habitats**
- **Egg types: All 3 fresh BMSB egg masses; as compared to being found in all Egg mass types in 2015**

Preliminary summary for 2016

- **<u>Predation</u> was significant, consuming >20% of eggs deployed.**
- **Successful parasitism was 2X as high in Frozen BMSB eggs than in either Fresh BMSB or Podisus eggs.**
- **Parasitoid species had habitat preferences.**
- **Native parasitoids were more successful this season at emerging from BMSB eggs than previous seasons.**
- ***Trissolcus japonicus* was present in 3 sites, all either open woods or scattered trees.**
- ***T. japonicus* was not present in abundance.**

Future research

- Continue to define the distribution and field behavior of *T. japonicus,* including habitat and host cues.
- Define conditions under which native parasitism and predation can be significant.

Acknowledgements

- Emma Thrift, Treva Rowley, Jeremy Turner, Kayla Pasteur, and Nate Erwin for help with laboratory and field work!
- Elijah Talamas for identifications and confirmations of parasitoids – congrats ET!

WV SEM Survey 2016

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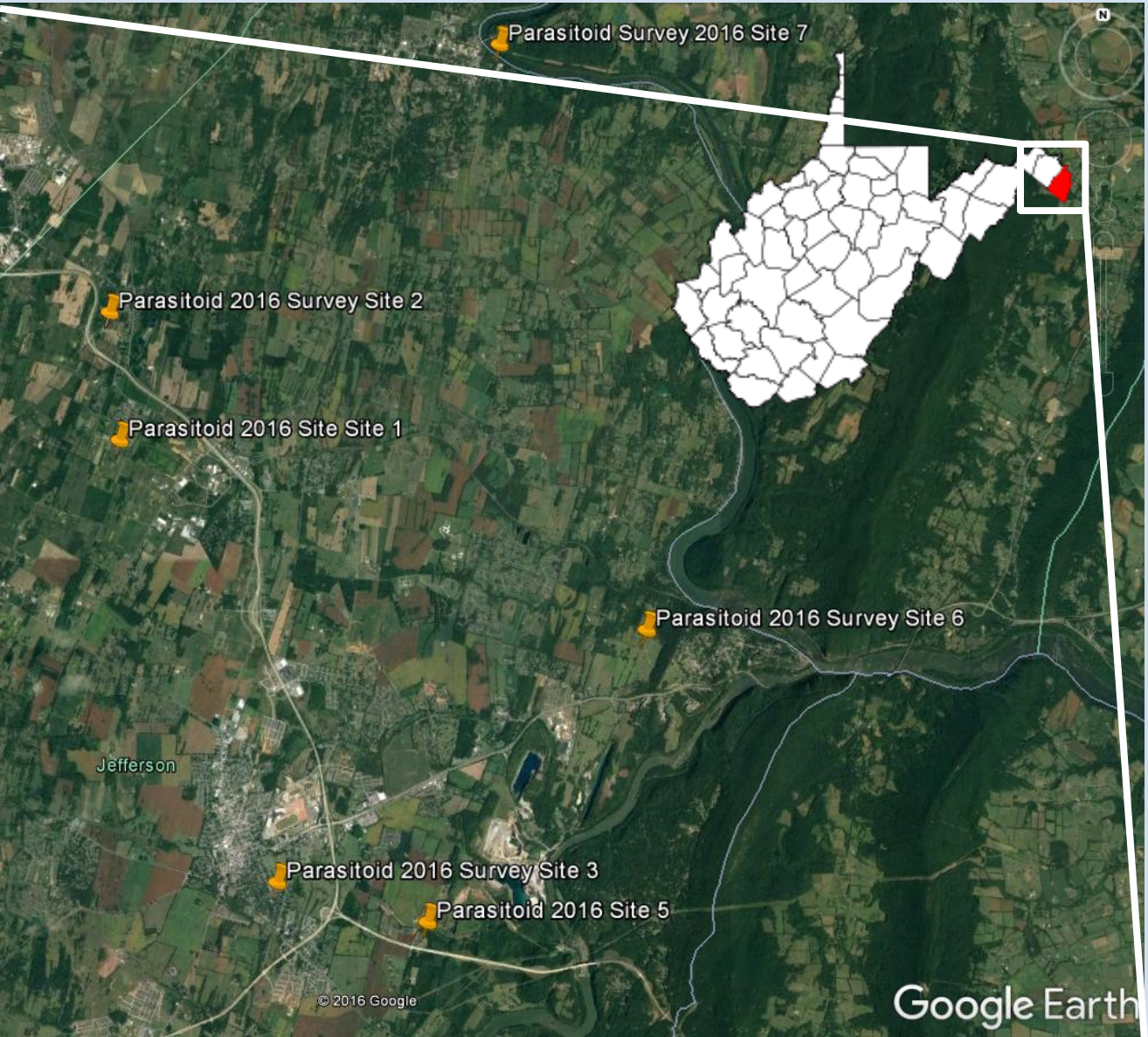
Summary of Effort



262 fresh SEMs deployed

6 sites in Jefferson Co., WV

3 host species
Tree of Heaven
Black Walnut
Black Locust

Habitats
Wooded edges

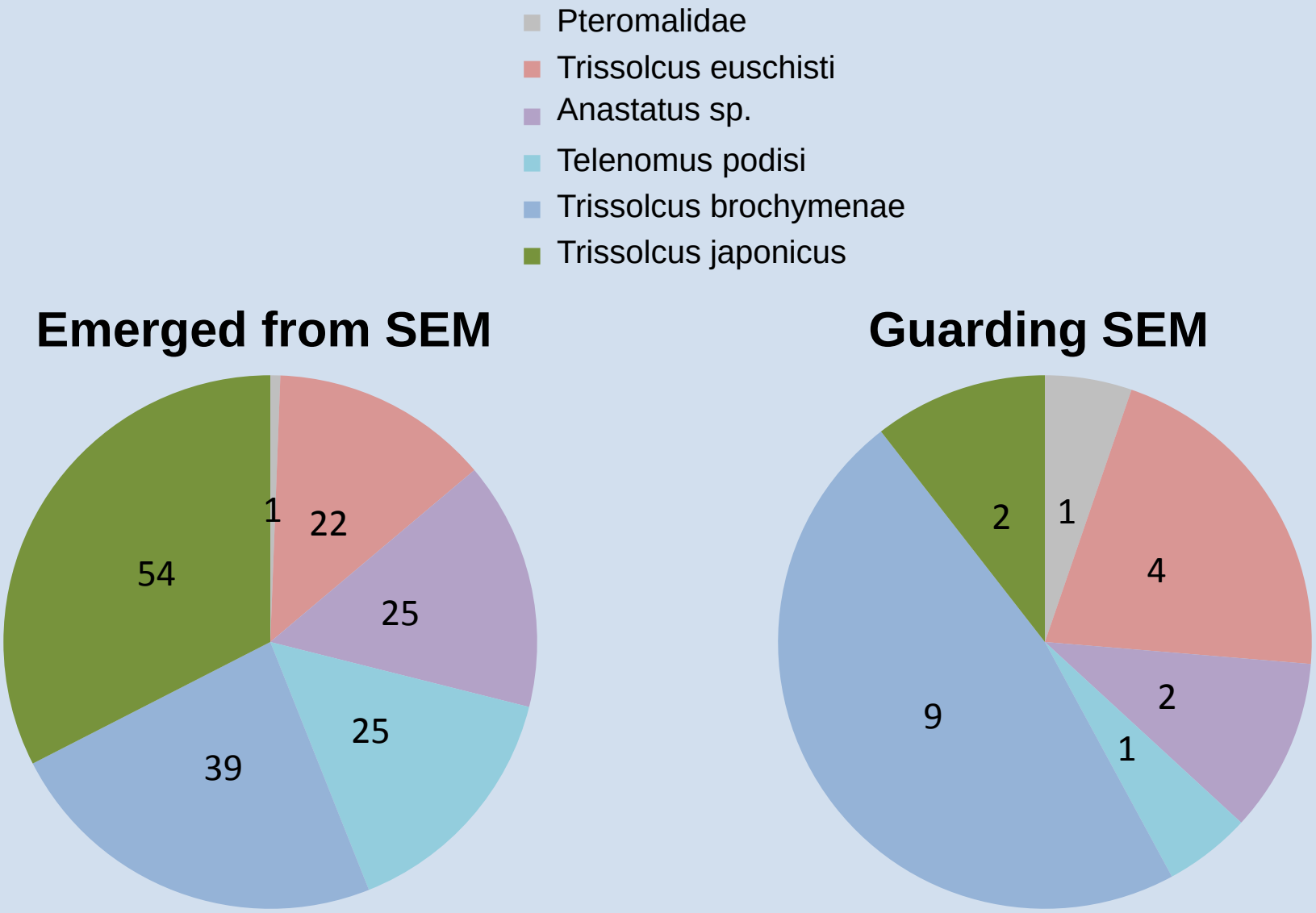
186 recovered parasitoid specimens

Deployment

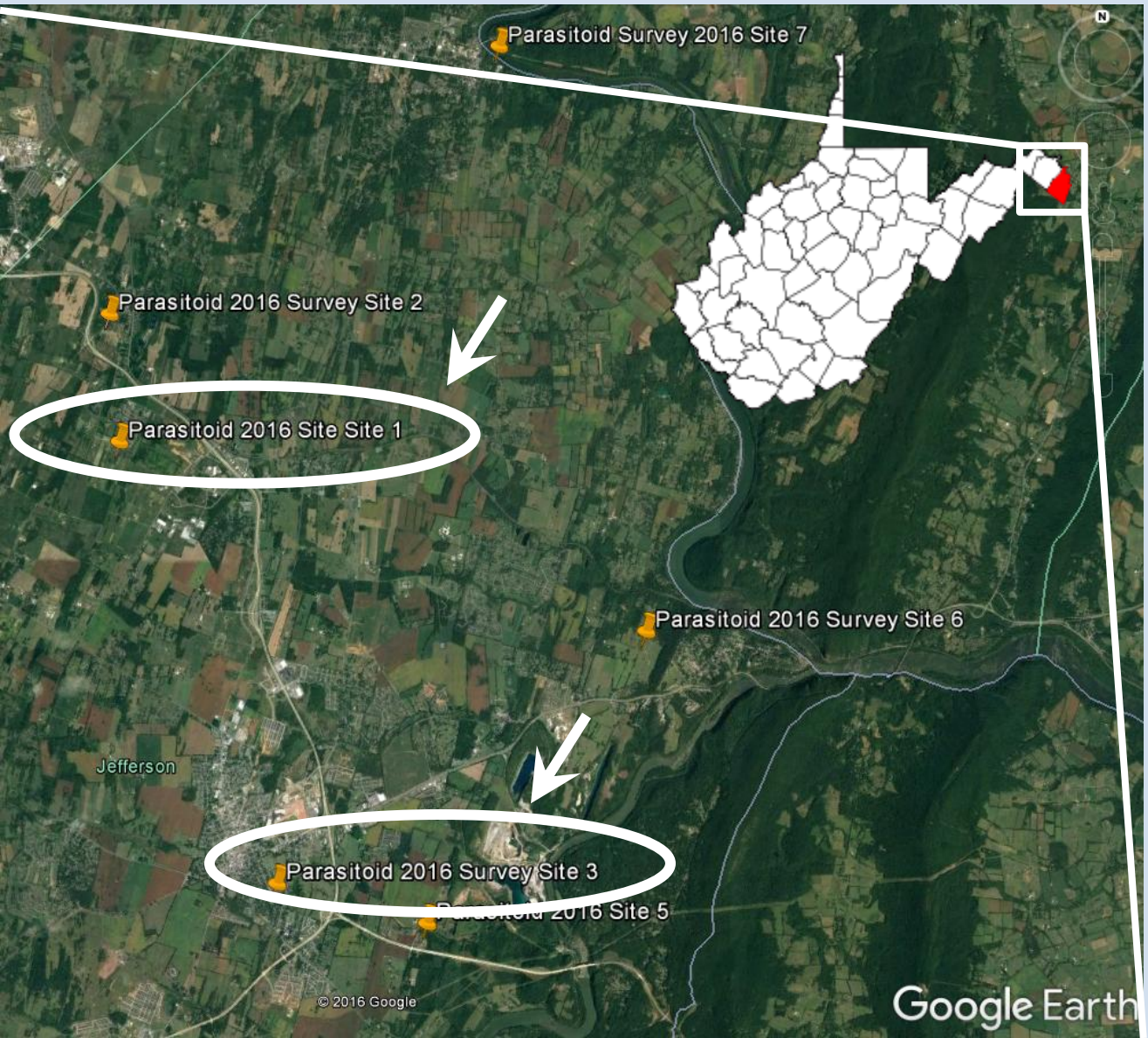
Typical woody edge site for deployment

Card affixed to the abaxial side of leaf

2016 Parasitoid Species Composition



New *Trissolcus japonicus* finds in WV



Tj by the numbers:

7 SEMs with emerged Tj

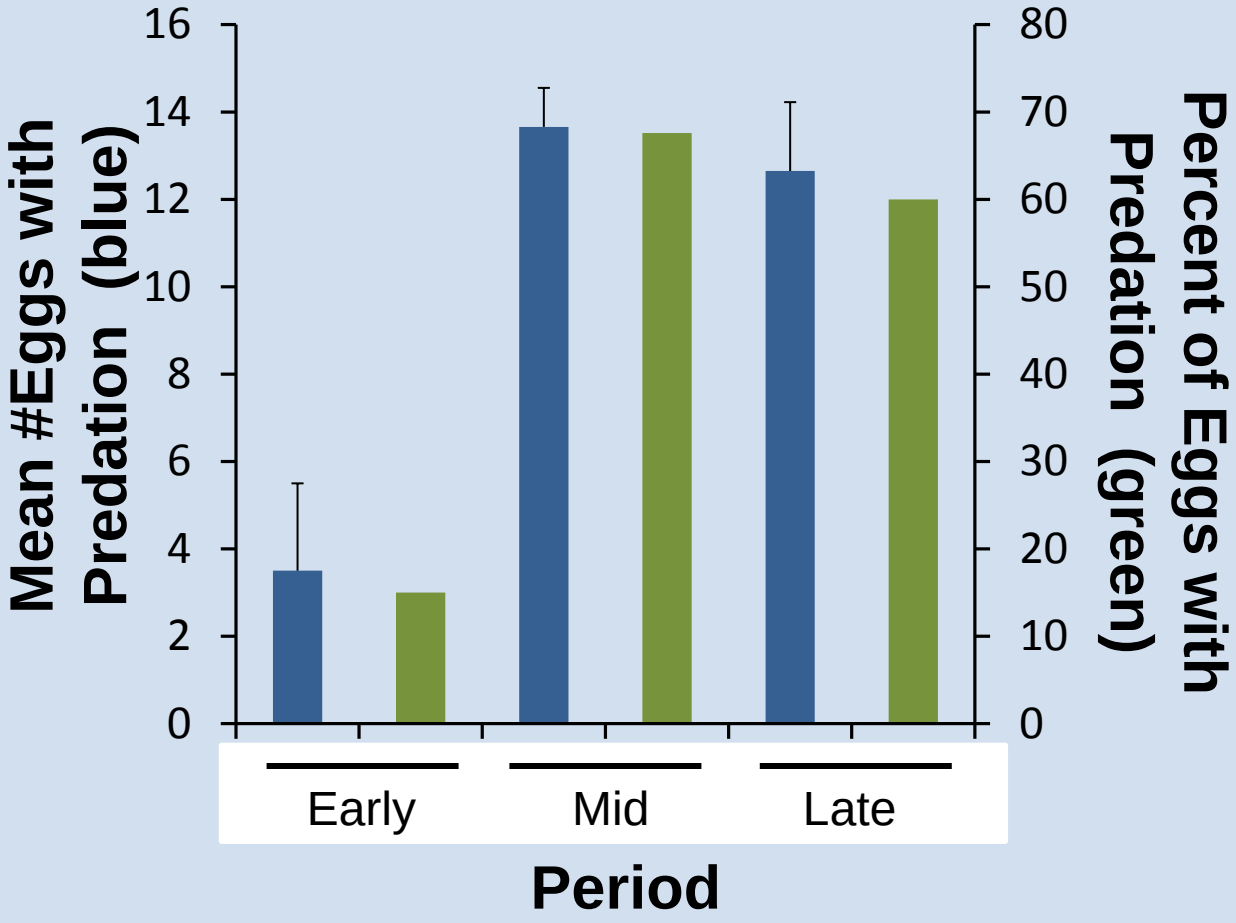
From 2 sites:
USDA-ARS-AFRS Charles Town, WV

56 Tj specimens

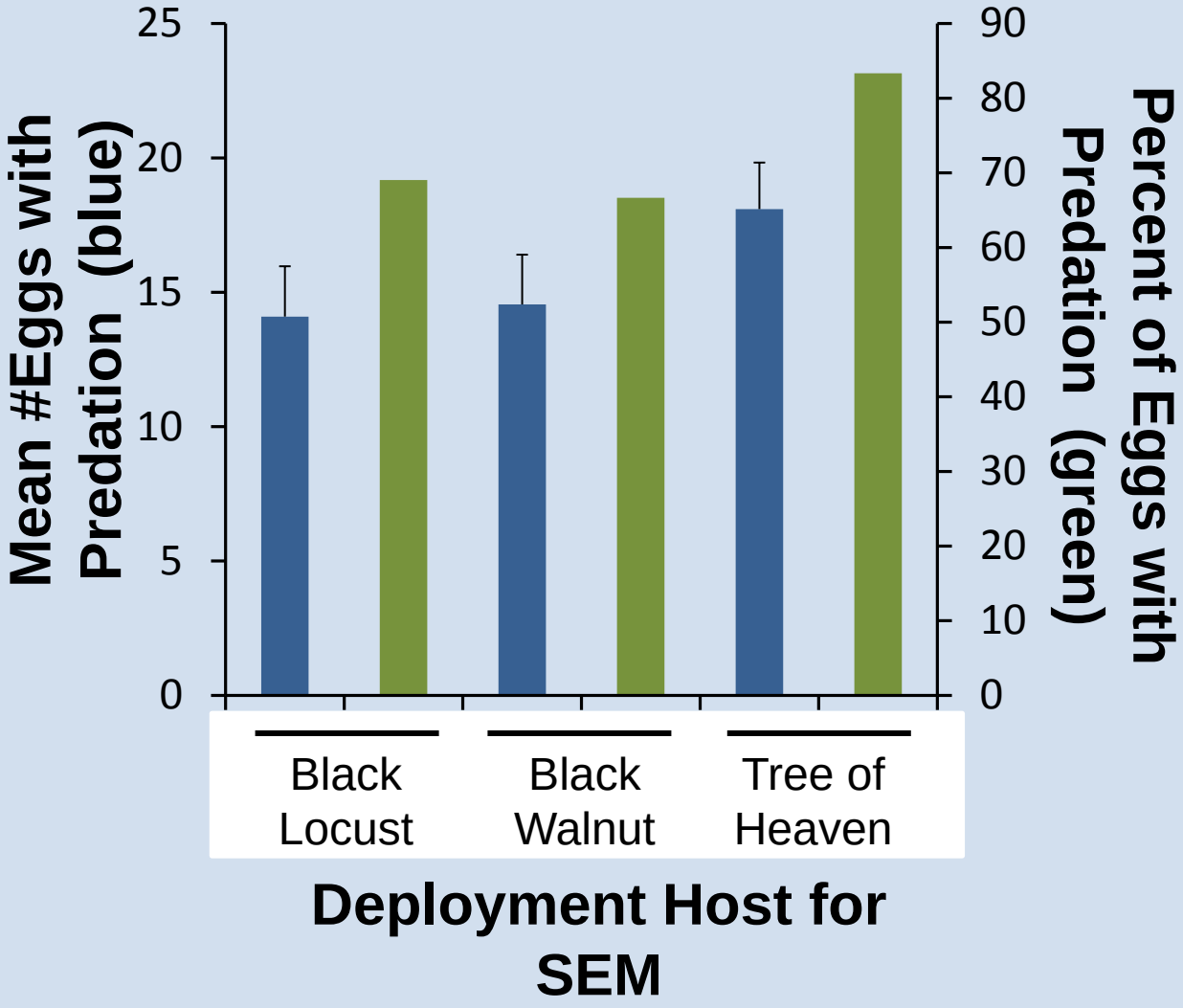
Mean **32.8%** egg parasitism

30% of all parasitoid specimens in 2016 were Tj

Predation During 2016



Predation During 2016



ARS BIIR Newark Sentinel Survey 2016

K. Tatman, A. Colavecchio & K. A. Hoelmer

USDA-ARS Beneficial Insects Introduction Research Unit, Newark, DE

Summary of Effort - BIIR

609 fresh SEMs deployed
86 SEMs parasitized (14%)
(7.5% parasitized eggs)

7 sites in
Newark & Bear, DE (Newcastle Co.), Harford Co. & Cecil Co. (MD)

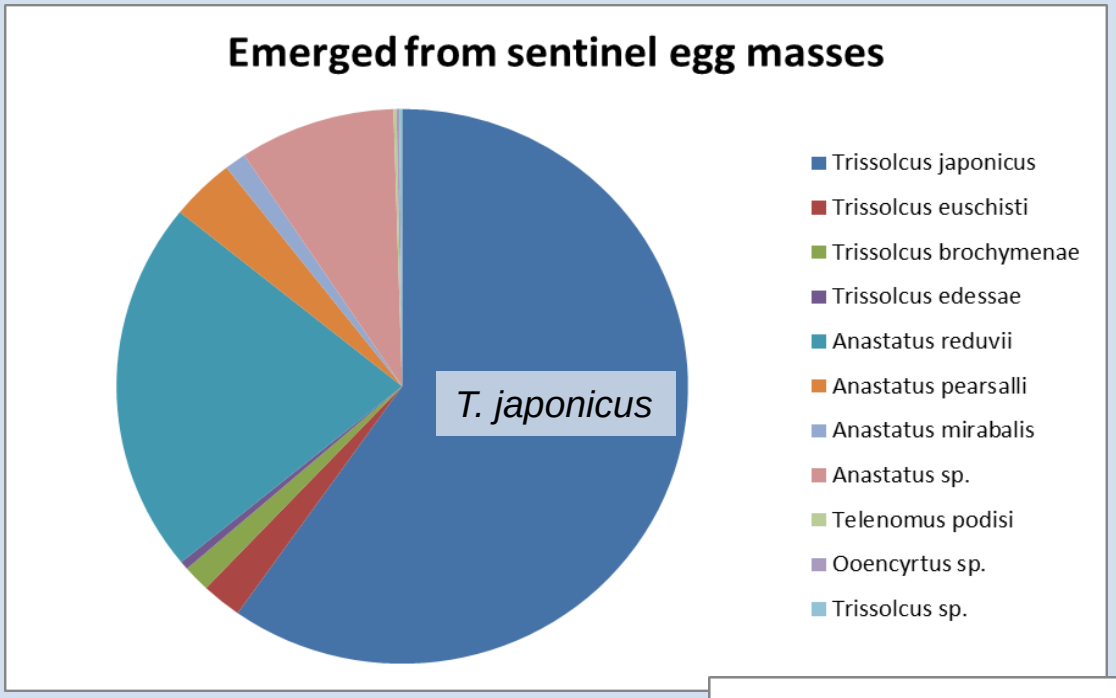
9 host species
Paulownia*, Ash*, Rhamnus, Holly, Chokecherry, Maple* (2 spp.), Redbud, Buddleia
(*=Tj found)

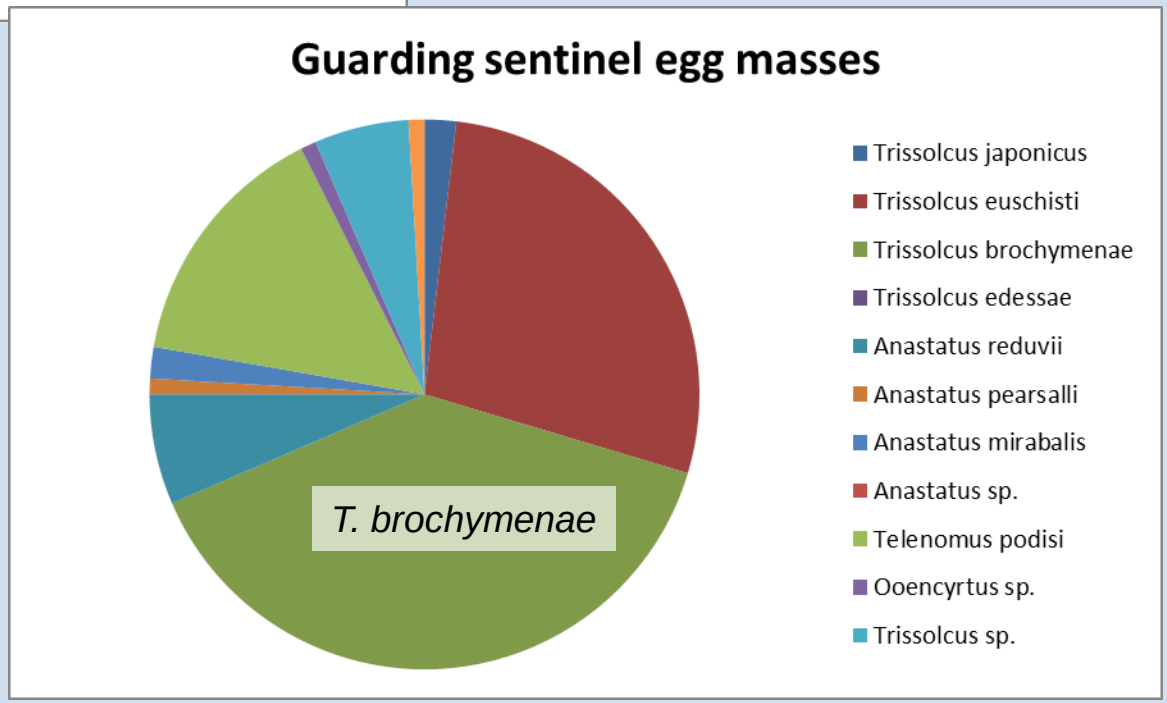
Habitats
Woodland edges, urban landscapes

1233 emerged parasitoid specimens
737 *T. japonicus*
55 native *Trissolcus spp.*
437 *Anastatus spp.*
4 other (*T. podisi, Ooencyrtus*)

108 attending female specimens
2 *T. japonicus*
78 native *Trissolcus spp.*
10 *Anastatus spp.*
2 other (*Gryon, Ooencyrtus*)

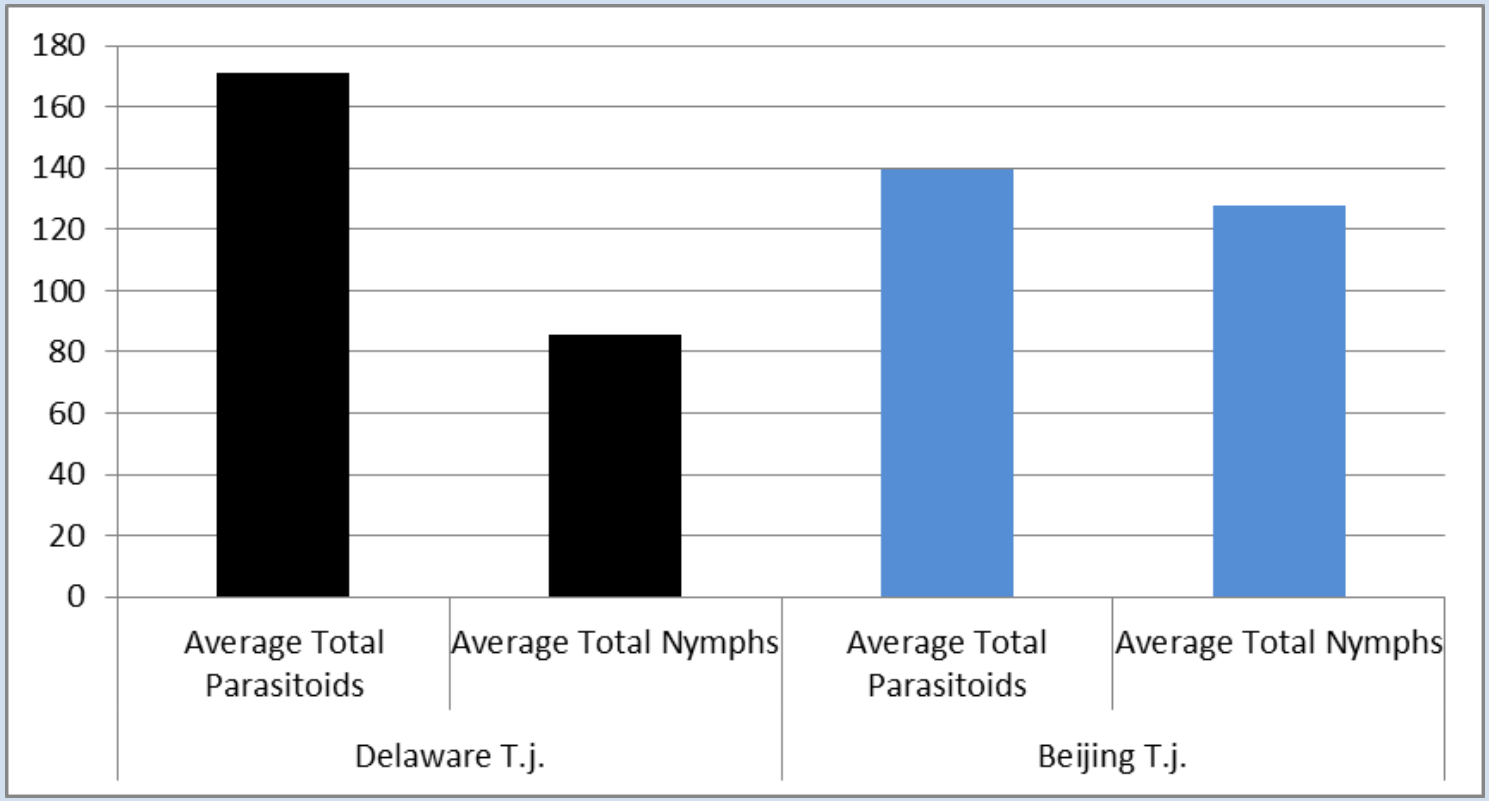
2016 Parasitoid Species Composition



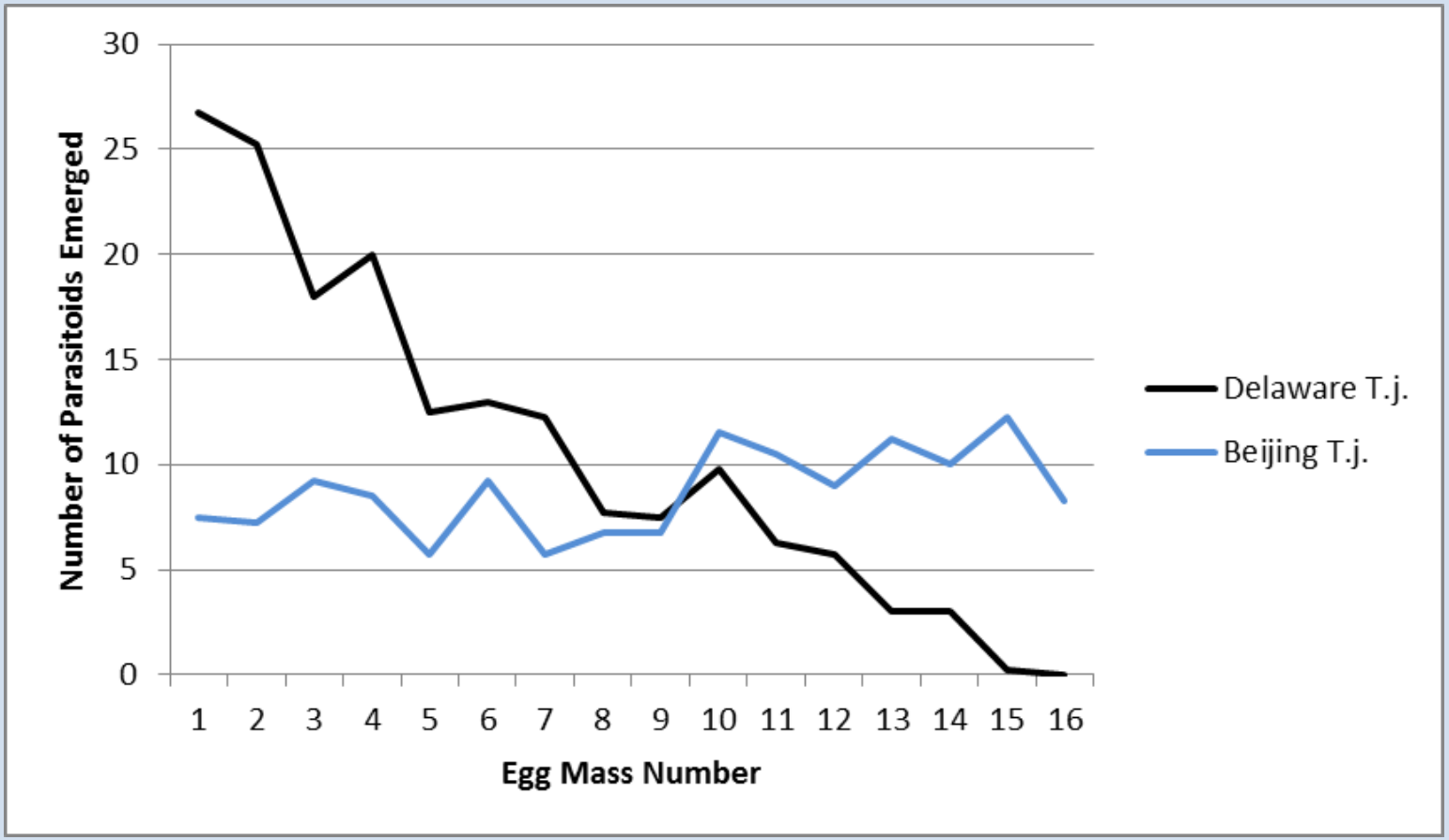


Reproductive Output

Adventive vs. Beijing *T. japonicus*



Total parasitoid and BMSB nymph emergence from ≤ 24 hr. old Delaware and Beijing *Trissolcus japonicus* females exposed sequentially to 16 BMSB egg masses. Females were moved to a new egg mass every 48 hours. N=4 replicates. Data from Zach Schumm.

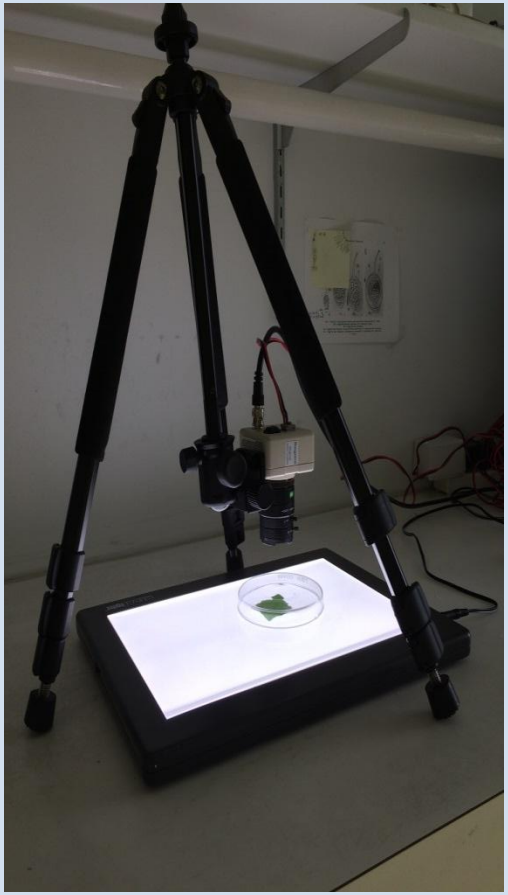


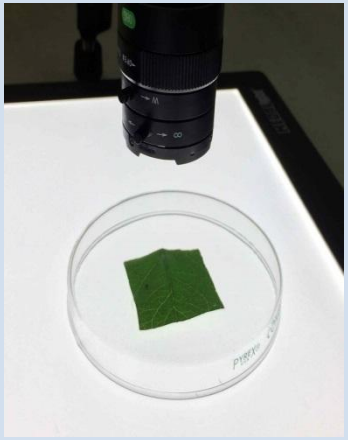
F1 progeny from ≤ 24 hr. old Delaware & Beijing *T. japonicus* females, each given 16 BMSB egg masses successively (a new egg mass every 48 hours). Delaware *T. japonicus* had ~89% parasitism rate (~28 eggs per egg mass) for the first 8 days (4 egg masses) which then tapered off, while the Beijing *T. japonicus* did not exceed 38% parasitism rate over any 8 day period.

(preliminary data from Zach Schumm. N=4 female replicates completed)

Influence of BMSB kairomone on leaf surface

Sean Boyle,
Univ. Delaware
Thesis research





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Tracking movements of female *T. japonicus* on leaf

Summary

- *T. japonicus* can detect kairomone traces of BMSB and *Podisus* adults on leaves
- *T. japonicus* alters its searching behavior when encountering these traces
- *T. japonicus* spends more time investigating traces of BMSB than of *Podisus*

Some overall sentinel egg trends for 2016

- **Predation can be significant in habitats tested (15-40% for fresh BMSB egg masses)**
- **Four genera (6 species) of native egg parasitoids regularly attack BMSB eggs, with variable emergence (common for *Anastatus*, to infrequent for *Telenomus*)**
- ***Trissolcus japonicus* is widespread (8 states + DC)**
- ***T. japonicus* was the most successful egg parasitoid at some sites, as measured in 2016 by adult emergence, but it was absent or uncommon at other sites**
- **Egg parasitoids have consistent habitat preferences; *T. japonicus* seems to prefer open woody habitat**
- **The Eastern *T. japonicus* has life history characteristics distinct from the Beijing strain in Newark BIIR culture**