Occurrence of Egg Parasitism in the Exotic Pest Brown Marmorated Stink Bug and the Native Beneficial Spined Soldier Bug in Maryland, DC, and Delaware

T. euschisti photo by Elijah Talamas

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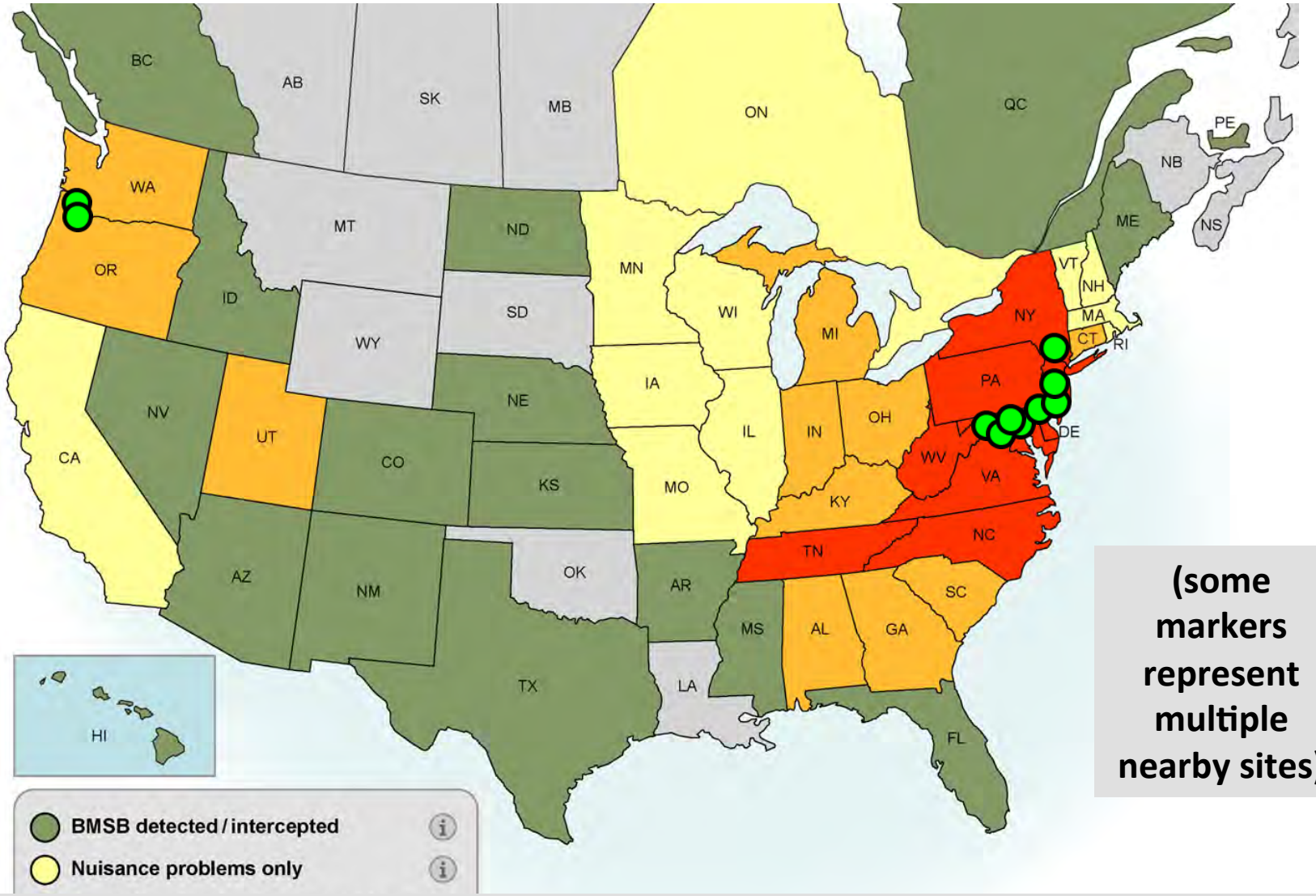
Questions

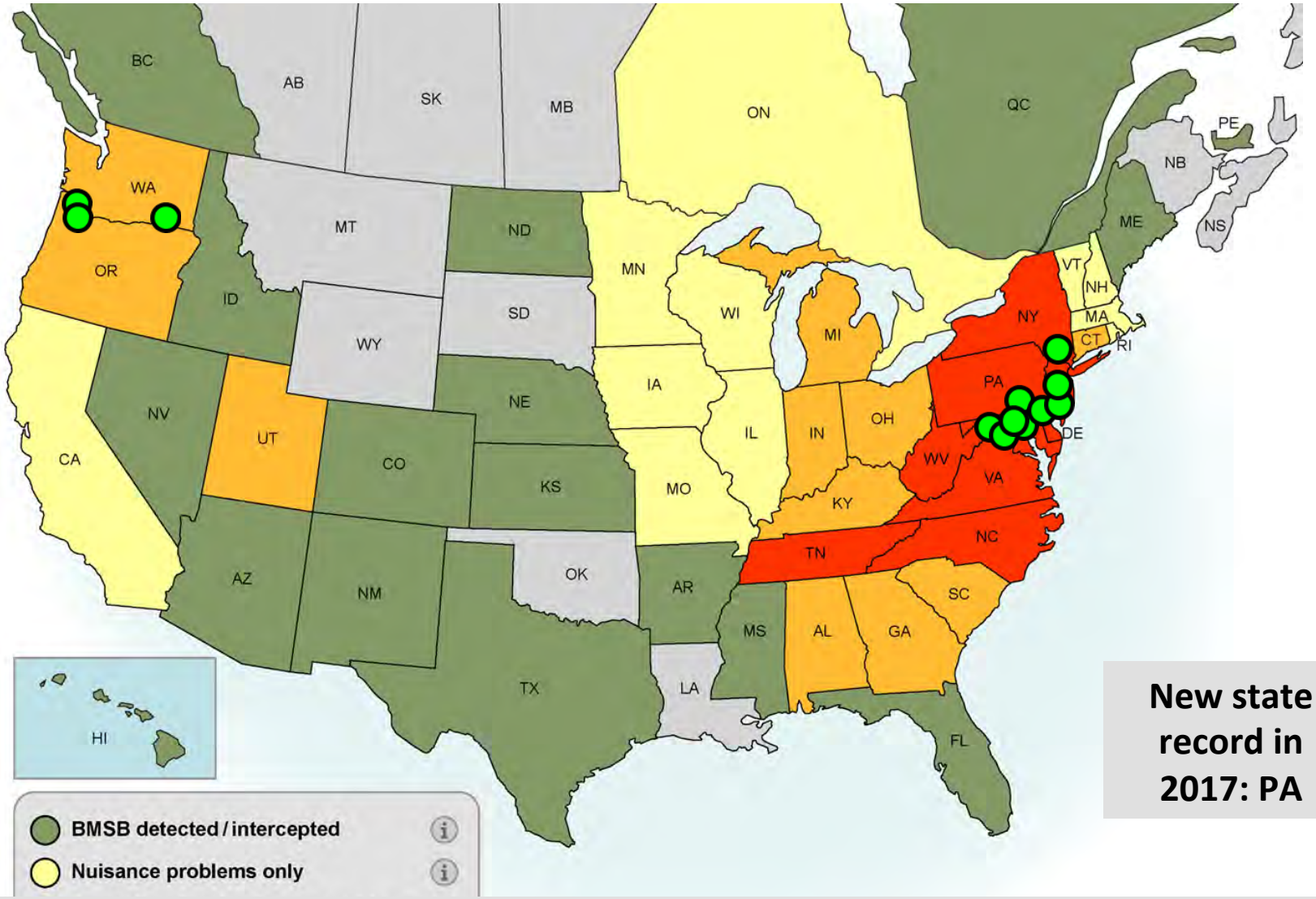
1. What is the current distribution of *T. japonicus*?
2. What are the habitat and canopy height preferences of *T. japonicus* as well as native parasitoids?
3. To what extent does *T. japonicus* parasitize native beneficial stinkbugs (e.g. *Podisus maculiventris*) ?
4. What is the attack and success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



(some markers represent multiple nearby sites)

Field recoveries of *Trissolcus japonicus*

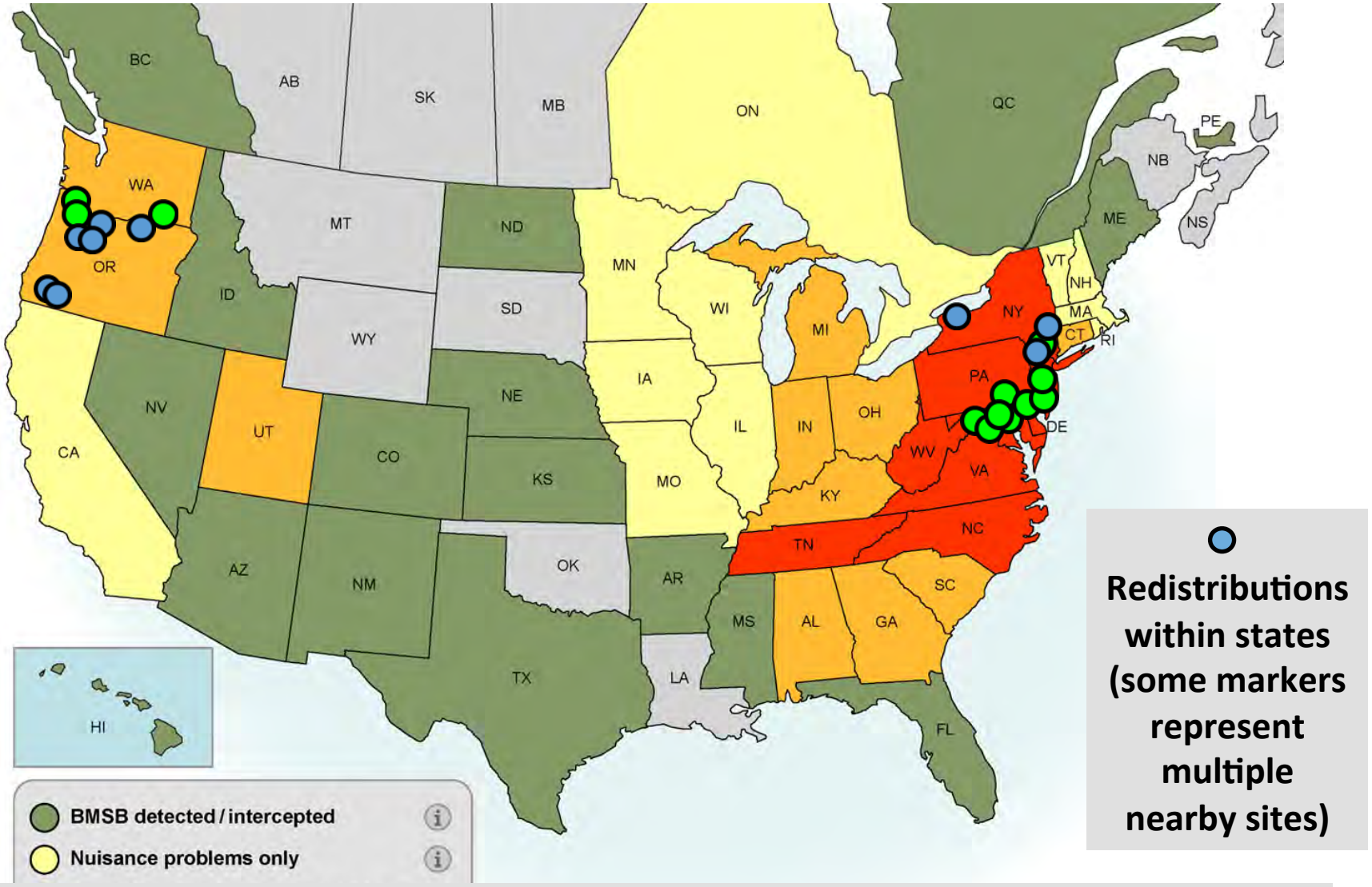
DC, MD, VA, WV, DE, NJ, NY, OR, WA (as of Dec. 2016)



New state record in 2017: PA

Field recoveries of *Trissolcus japonicus*

DC, MD, VA, WV, DE, PA, NJ, NY, OR, WA (as of Dec. 2017)



Field recoveries of *Trissolcus japonicus*

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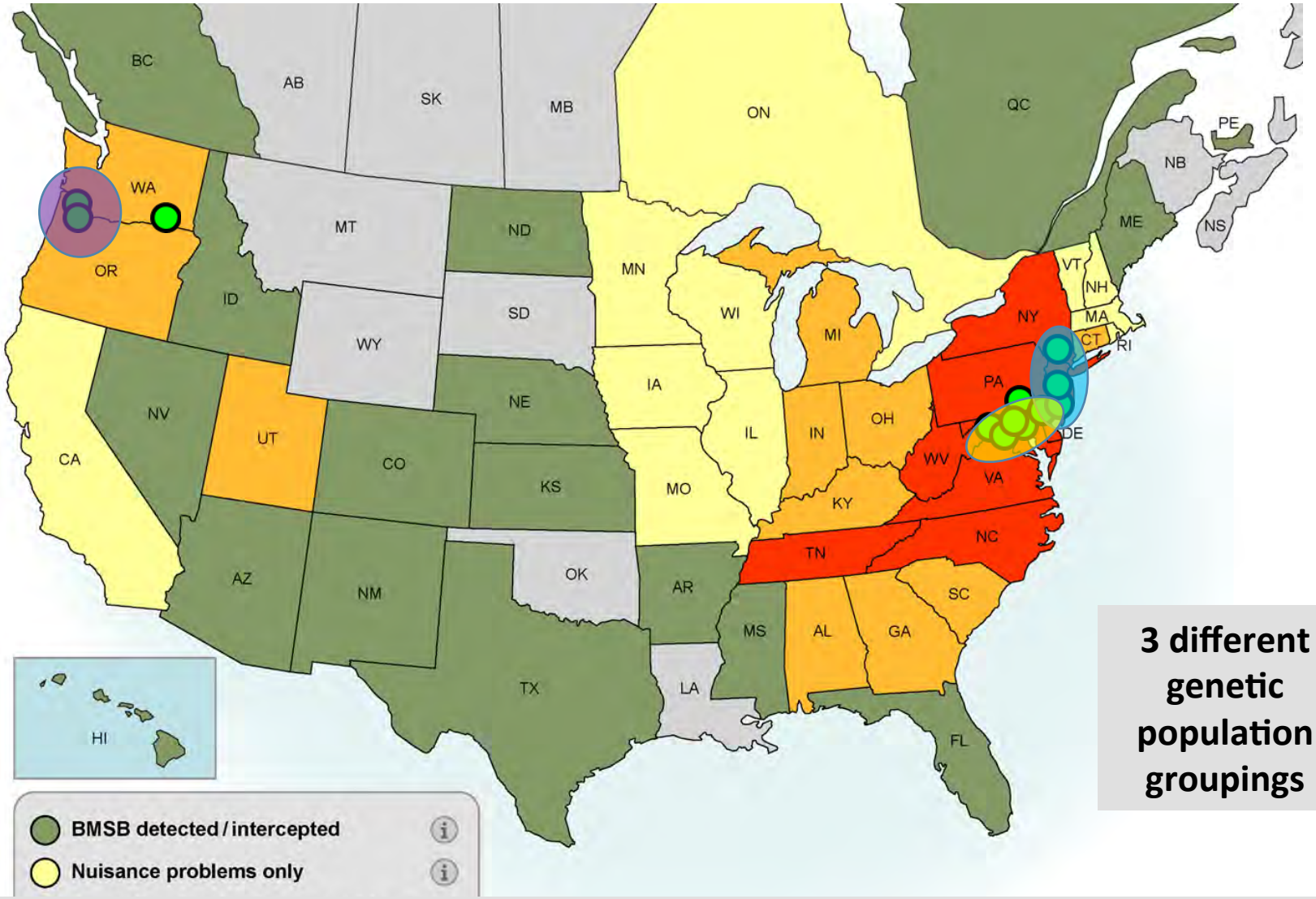


3 different genetic population groupings

Field recoveries of *Trissolcus japonicus*

DC, MD, VA, WV, DE, PA, NJ, NY, OR, WA (as of Dec. 2017)

Maryland Methods: 3 Habitat types

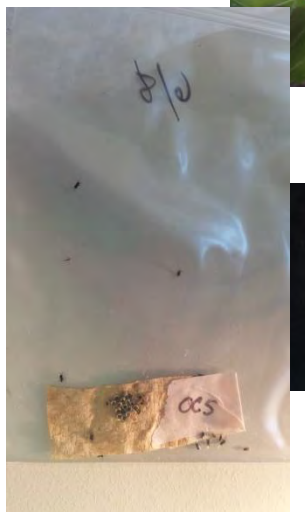
- Field crop (soybean)
- Orchard (apple) or scattered trees
- Woods (various native and invasive vegetation)

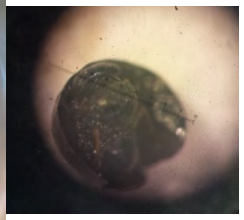
Maryland Methods: 2 Egg mass Treatments

- ≤24-hour-old BMSB eggs
- ≤24-hour-old *Podisus maculiventris* eggs

Methods: Experimental design

- Sentinel eggs laid on paper towels by colony insects were either:
  - pinned to various vegetation at each site and were exposed for 72 hrs.
  - Taped to bamboo poles at 5’, 10’, 15’, 20’ at Woods or “Orchard” sites.
- 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.





Overview of Results

	2015		2016		2017	
# eggs deployed (all types)	42,177		15,774		9,534	
# eggs recovered (all types)	26,694		11,276		6,552	
% predation	36.7 %		28.5 %		33%	
% pupae	5%		3%		0.63%	
Parasitism	**% Successful (#)**	**% Stuck (#)**	**% Successful (#)**	**% Stuck (#)**	**% Successful (#)**	**% Stuck (#)**
Anastatus reduvii	**1.4 %** (388)	**0.1%** (36)	**2.0 %** (231)	**0.2%** (18)	**3.2%** (207)	**1%** (64)
Trissolcus japonicus	**1.0 %** (274)	**0.03%** (9)	**0.2 %** (23)	**--**	**0.08%** (5)	--
Tr. euschisti	**3.9 %** (1050)	**0.5%** (123)	**2.1 %** (241)	**0.1%** (15)	**1.3%** (87)	**0.1%** (9)
Tr. brochymenae	**1.9 %** (510)	**0.5%** (127)	**0.3%** (30)	**--**	**0.2%** (13)	--
Tr. edessae	**0.6 %** (161)	**0.08%** (22)	**0.3%** (32)	**--**	**0.2%** (16)	**--**
Telonomus podisi	**0.7 %** (199)	**2.1 %** (572)	**0.4%** (40)	**1.3 %** (144)	**0.07%** (5)	**1.3%** (88)
Ooencyrtus johnsoni	**0.9 %** (242)	**0.05%** (13)	**0.3%** (31)	**0.2%** (21)	**0.6%** (43)	**0.03%** (2)
TOTAL % parasitized	**10.6 %** (2775)	**3.6 %** (975)	**5.6 %** (628)	**1.8 %** (198)	**5.7%** (376)	**2.5%** (161)

Results: Predation

Pinned Egg masses

	# of eggs predated	Total number of eggs recovered	Total % predated	Chewing predation	Sucking predation
P. maculiventris	1538	2347	26%	99.9%	0.1%
BMSB	621	4205	12%	99.2%	0.8%
total	2159	6552	23%	99.7%	0.3%

Results: Predation

- **On Bamboo By Height**

	# of eggs deployed	# of eggs predated	Total number of eggs recovered	Total % predated	Chewing predation	Sucking predation
P. maculiventris						
5'	573	227	329	**40%**	100%	0%
10'	485	160	307	**33%**	93%	7%
15'	444	214	187	**48%**	100%	0%
20'	304	144	135	**47%**	100%	0%
BMSB						
5'	905	44	850	**5%**	100%	0%
10'	1009	66	897	**6%**	98.5%	1.5%
15'	820	103	714	**13%**	98%	2%
20'	657	116	534	**18%**	100%	0%

Results by egg type (pinned egg masses)

	eggs recovered	**% emerged parasitoids**	% *Trissolcus japonicus* LIVE	% *Trissolcus* native spp. LIVE	% *Telenomus podisi* LIVE	% *Anastatus* LIVE	% Ooencyrtus johnsonii, ALIVE	**% dead parasitoids**	% *Trissolcus japonicus* DEAD	% *Trissolcus* native spp. DEAD	% *Telenomus podisi* DEAD	% *Anastatus* DEAD	% Ooencyrtus johnsonii, DEAD
BMSB	4205	**6.2%**	0.2%	0.6%	0.02%	4.5%	0.9%	**1.8%**	0%	0.1%	0.2%	1.5%	0.05%
Podisus	2347	**5%**	0%	4%	0.2%	0.7%	0.1%	**3.7%**	0%	0.2%	3.5%	0.04%	0%

Results by habitat (pinned egg masses)

	eggs recovered	**% emerged parasitoids**	% *Trissolcus japonicus* LIVE	% *Trissolcus* native spp. LIVE	% *Telenomus podisi* LIVE	% *Anastatus* LIVE	% Ooencyrtus jpohnsonii, ALIVE	**% dead parasitoids**	% *Trissolcus japonicus* DEAD	% *Trissolcus* native spp. DEAD	% *Telenomus podisi* DEAD	% *Anastatus* DEAD	% Ooencyrtus johnsonii, DEAD
Orchard	2656	**5.8%**	0%	2.8%	0%	3%	0%	**2.3%**	0%	0.3%	0%	2%	0%
Soy	823	**0.6%**	0%	0%	**0.6%**	0%	0%	**7.2%**	0%	0%	**7.2%**	0%	0%
Woods	3073	**7%**	**0.2%**	1.4%	0%	4.2%	1.4%	**1.3%**	0%	0.07%	0.9%	0.3%	0.06%

Results by egg type and Bamboo Pole height (site types are combined)

	eggs recovered	**% emerged parasitoids**	% *Trissolcus japonicus* LIVE	% *Trissolcus* native spp. LIVE	% *Telenomus podisi* LIVE	% *Anastatus* LIVE	% Ooencyrtus johnsonii, LIVE	**% dead parasitoids**	% *Trissolcus japonicus* DEAD	% *Trissolcus* native spp. DEAD	% *Telenomus podisi* DEAD	% *Anastatus* DEAD	% Ooencyrtus johnsonii, DEAD
BMSB													
5'	850	**1%**	--	0.1%	--	0.8%	0.1%	**0.5%**	--	--	--	--	0.5%
10'	897	**0.1%**	--	--	--	0.1%	--	**0%**	--	--	--	--	--
15'	714	**1.3%**	--	--	--	1.3%	--	**0%**	--	--	--	--	--
20'	534	**0%**	--	--	--	--	--	**0%**	--	--	--	--	--
Podisus													
5'	329	**7%**	--	1%	--	--	6%	**3%**	--	3%	--	--	--
10'	307	**20%**	--	20%	--	--	--	**3%**	--	3%	--	--	--
15'	187	**11%**	--	11%	--	--	--	**0%**	--	--	--	--	--
20'	135	**10%**	--	10%	--	--	--	**0%**	--	--	--	--	--

Results by parasitoid species (pinned egg masses)

	2015		2016		2017	
	% of parasitized	% of parasitoid adults stuck inside eggs	% of parasitized	% of parasitoid adults stuck inside eggs	% of parasitized	% of parasitoid adults stuck inside eggs
A. reduvii	11%	8%	30%	7%	55%	38%
T. japonicus	7.5%	3%	3%	0%	1%	0%
T. euschisti	31%	10%	31%	6%	23%	6%
T. brochymenae	9%	20%	4%	0%	4%	0%
T. edessae	5%	12%	4%	0%	5%	0%
Te. podisi	21%	75%	22%	78%	1%	55%
O. johnsonii	7%	5%	6%	40%	11%	1%

Results: *Trissolcus japonicus*

- **Numbers remain low: Only 1 egg mass at the BARC sites (total of 5 eggs)**
- **High rate of successful emergence (100%)**
- **Habitats: Egg mass found at original detection site**
- **Not found in bamboo pole trials**

Preliminary summary for 2017

- **Predation was significant, consuming >20% of eggs deployed.**
- **Parasitoid species had habitat preferences.**
- **Native parasitoids were more successful this season at developing and emerging from BMSB eggs than previous seasons.**
- **At BARC, *Trissolcus japonicus* was present only at the original detection site.**
- **Established, but at very low numbers; Increase in BMSB population this year-Maybe not a good match of strains.**
- **In other areas of the country (NY and WA) *T. japonicus* has spread, but remains at very low numbers.**

Acknowledgements

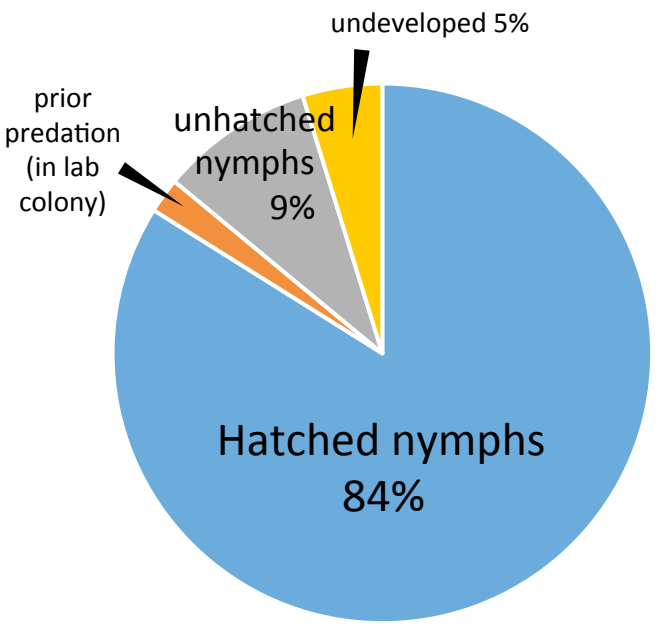
- Kayla Pasteur, Jeremy Turner, Anna Wallingford, and Nathan Erwin for help with laboratory and field work!

BIIRU Newark 2017
BMSB Sentinel Egg masses:

572 masses placed on foliage
(shoulder height)
vs.
854 placed on bamboo poles
tied to tree trunk (various heights)

vs.

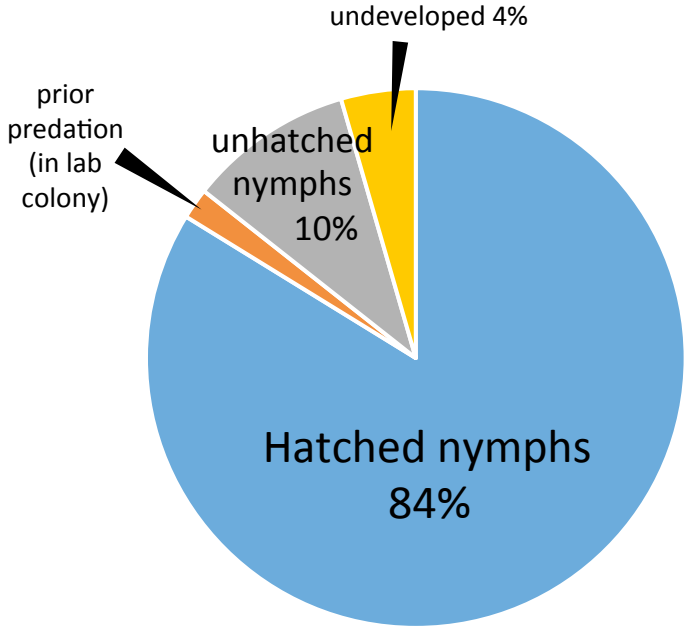
Fate of Control BMSB Eggs in Field (within mesh cages)



N = 115 egg masses with 3,125 eggs total

22 egg masses (19%) had 100% hatch of nymphs

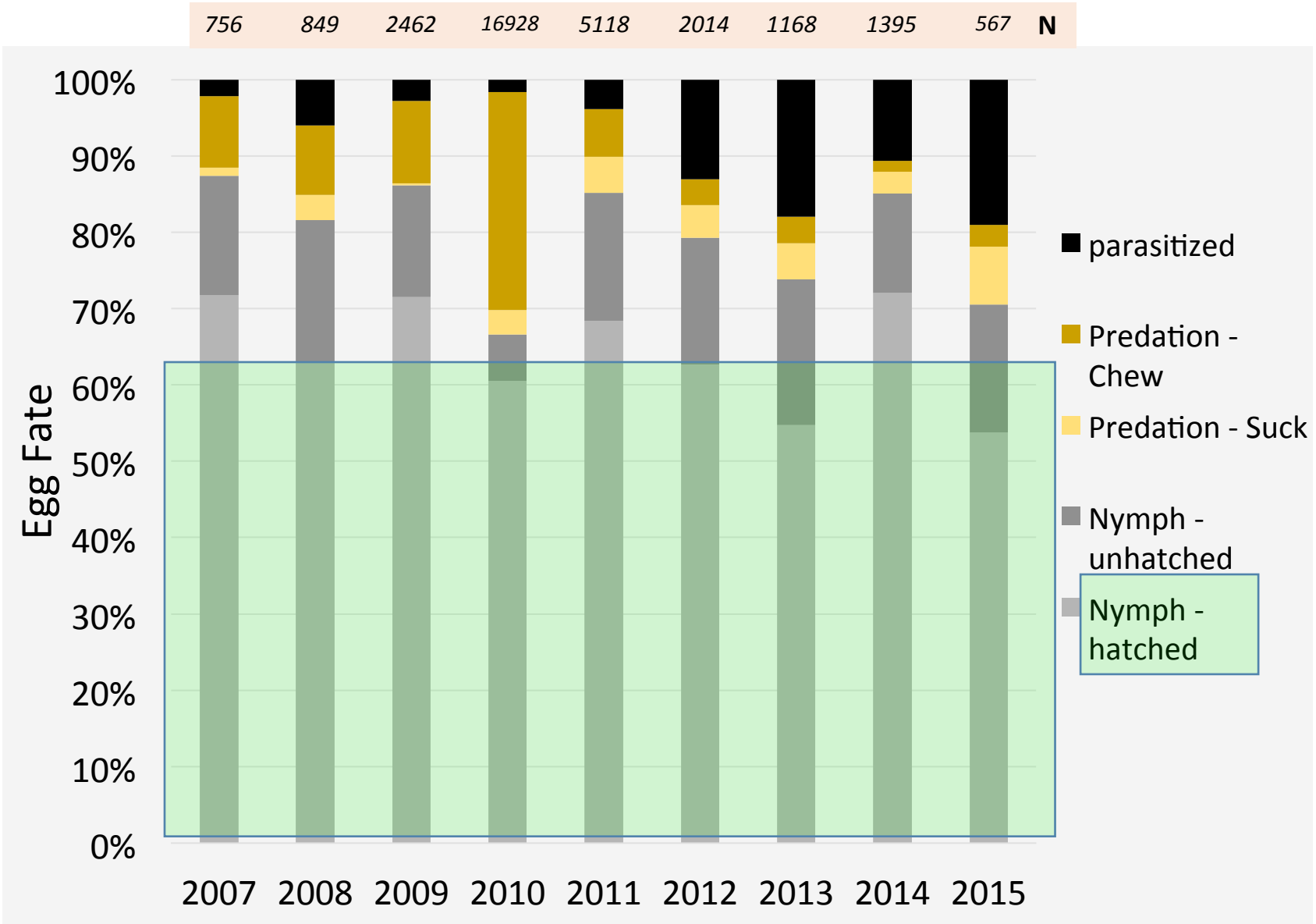
Fate of BMSB Egg Controls Kept in Laboratory



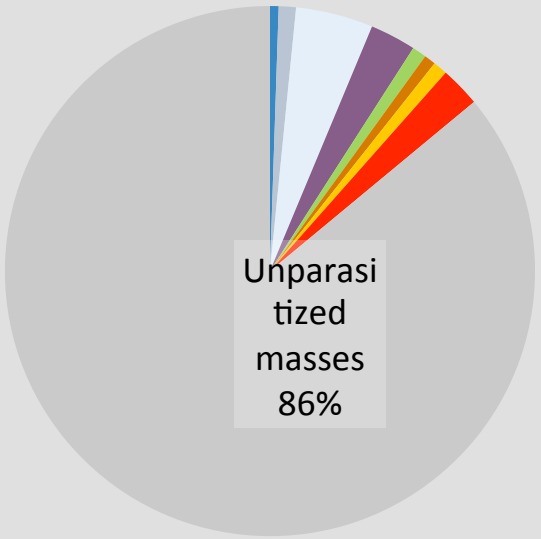
N = 62 egg masses with 1,677 eggs total

13 egg masses (21%) had 100% hatch of nymphs

Fate of naturally laid **BMSB** eggs



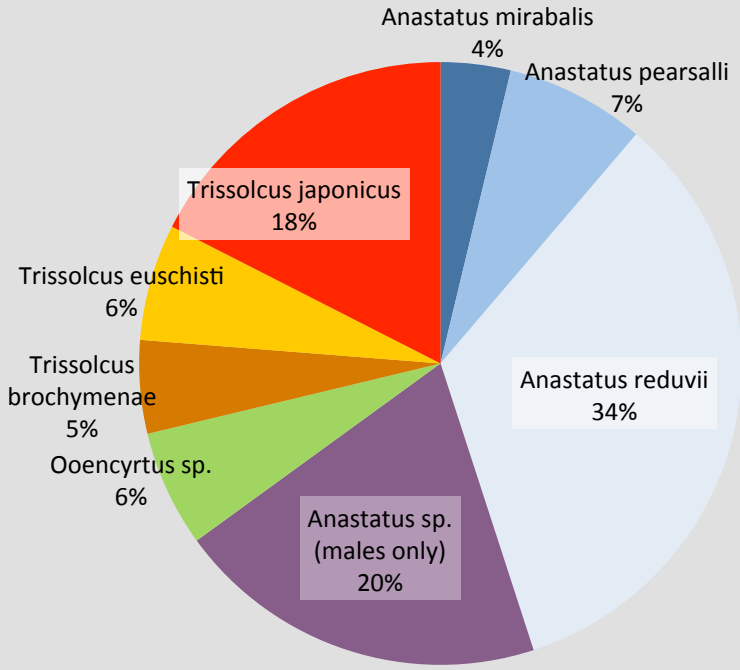
BIIRU Newark 2017 Sentinel Egg masses (placed on foliage)



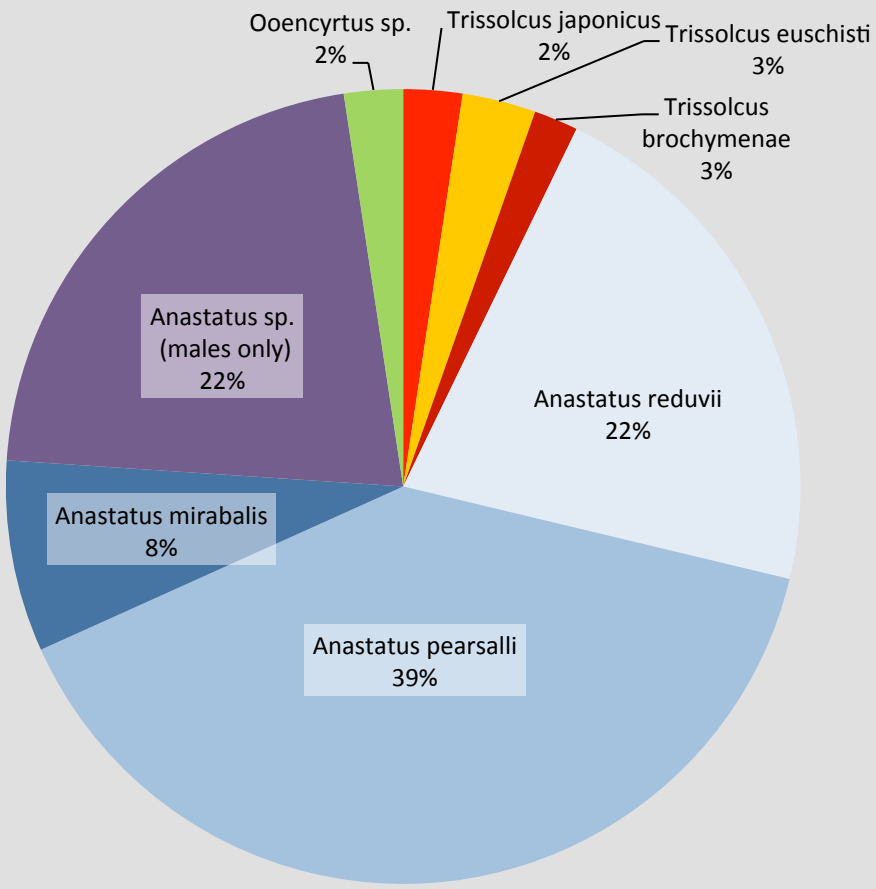
N placed = 572

N parasitized = 80 (14.0% of total)

N with 2 or more parasitoid spp. emerged = 8



Emerged Parasitoid Species Composition

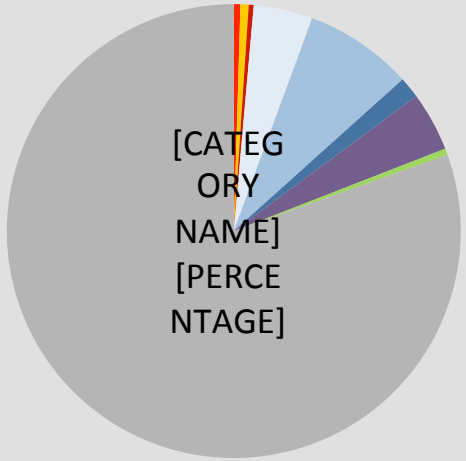


N placed = 854

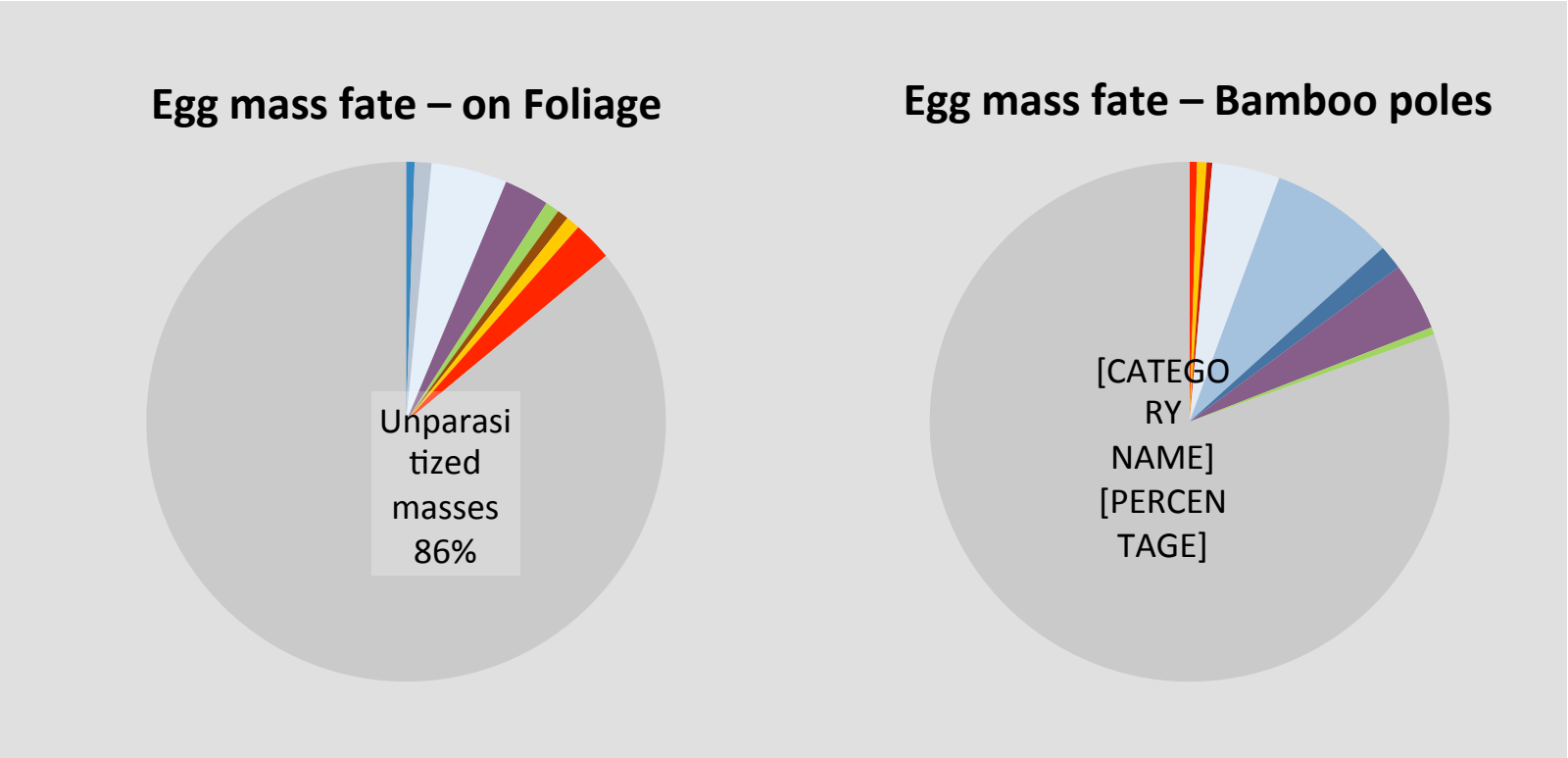
N parasitized = 167
(19.6% of total)

N with 2 or more parasitoid spp. emerged = 10

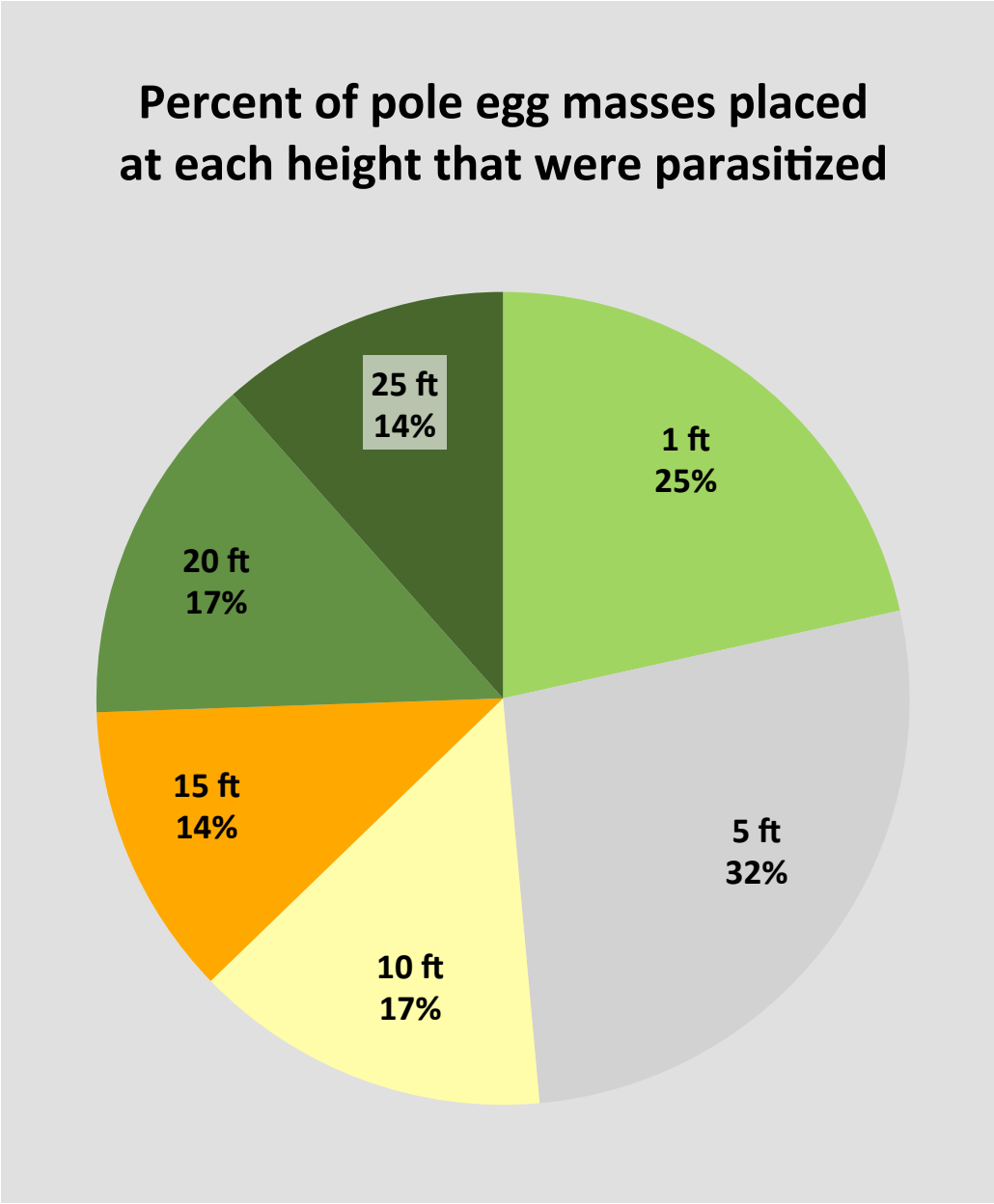
Egg mass fate



BIIRU Newark 2017
Sentinel Egg masses
(placed on bamboo poles)



- Higher parasitism by *Trissolcus* on foliage
- Higher parasitism by *Anastatus* on bamboo stakes near trunk



N of egg masses placed at each height:

185 *at 1,5 & 10 ft*

174 *at 15 ft*

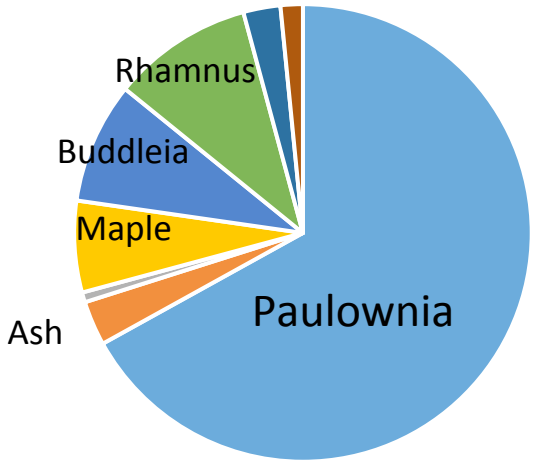
103 *at 20 ft*

22 *at 25 ft*

Levels of egg mass parasitism were similar at all placement levels (primarily due to *Anastatus*)

Proportional Placement of Sentinel Egg Masses on Eight Different Host Plants

N = 572

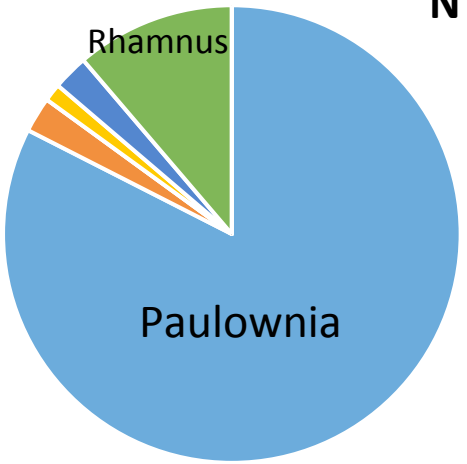


Plants with no parasitism

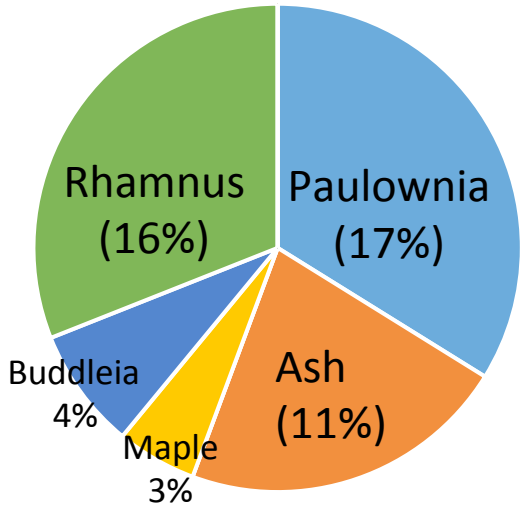
- Ilex (holly)
- Cercis (redbud)
- Quercus (oak)

Proportion of Total Parasitized Egg Masses on Different Host Plants

N = 80



Sentinels on foliage of different host plants



Relative Proportion of Egg Masses Parasitized on each Host Plant

BIIR Newark Wild BMSB and Non-Target Egg Masses in 2017

20 “wild” BMSB egg masses were collected. Only one was parasitized, by *Anastatus reduvii*.

35 “wild” native, non-target stink bug egg masses were collected. 11 (31%) were parasitized. **No *Trissolcus japonicus* emerged** from these egg masses. Egg masses included: 3 *Brochymenae quadripustulata*; 11 *Chinavia hilaris*; 15 *Euschistus tristigmus*; 3 *Euschistus servus*; 1 *Murgantia histrionica*; 1 *Podisus maculiventris*; and 1 *Thyanta custator*.

We placed 41 lab-reared native sentinel egg masses, but none were parasitized. The egg masses included: 12 Podisus maculiventris ; 8 *Murgantia histrionica*; 2 *Oebalus pugnax*; 11 *Euschistus tristigmus*; 5 *Euschistus servus*; 1 *Amaurochorus* sp.; 1 *Mormidea lugens*; and 1 *Thyanta custator.*