Making Sense of Brown marmorated stink bug biological control

Brown Marmorated Stink Bug Working Group Meeting
Rutgers University, 16 June 2016

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Questions

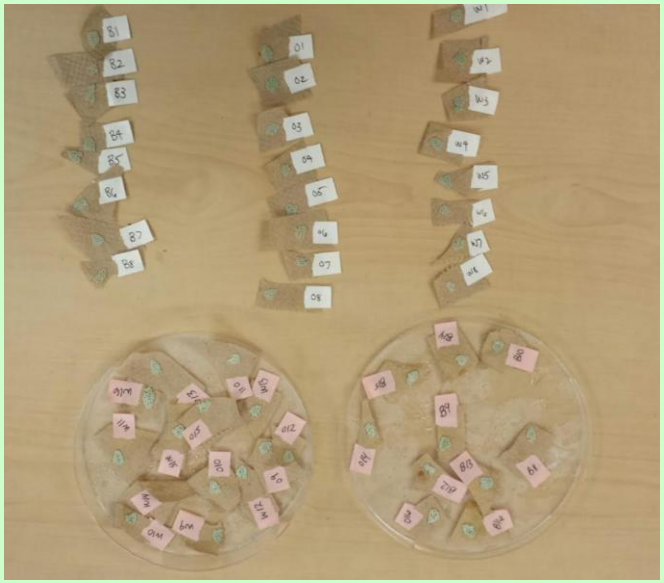
1. **Is the *Trissolcus japonicus* detected in MD in 2014 an established population?**
2. **What are the habitat preferences of *T. japonicus* as well as native parasitoids?**
3. **If established, what is the impact of *T. japonicus* on native beneficial stinkbugs (such as *Podisus maculiventris*) ?**
4. **What is the attack and success rate of parasitism by native parasitoids?**

Methods:
3 Habitat types

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

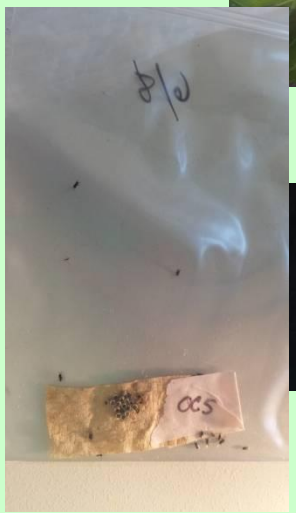
Methods:
3 Egg mass Treatments

- **≤24-hour-old BMSB eggs**
- **≤24-hour-old BMSB eggs frozen at -80°C for 2 min.**
- **≤24-hour-old *Podisus maculiventris* eggs**

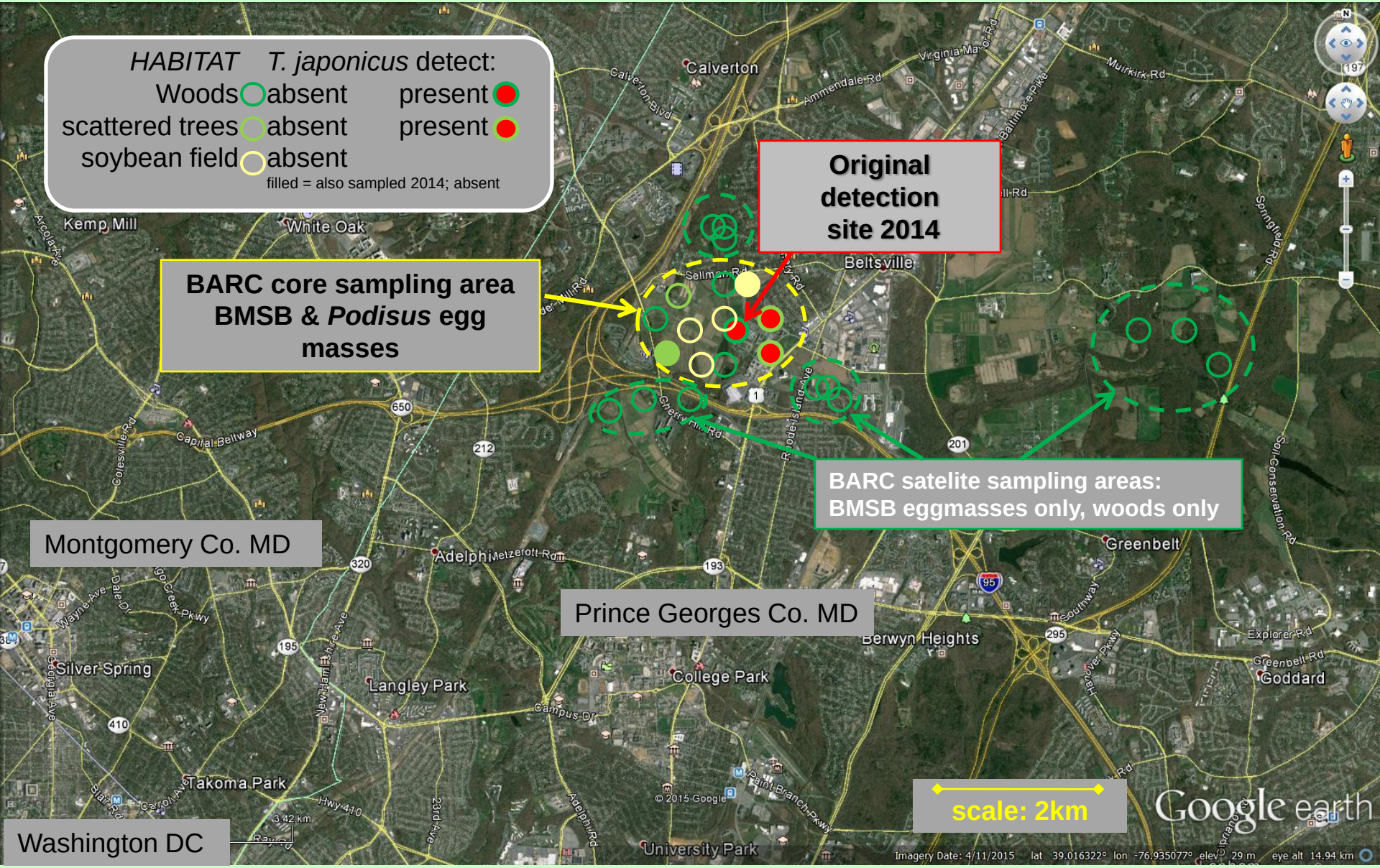


Methods: Experimental design

- **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.**
- **Emerged and dissected parasitoids were sent to Elijah Talamas (USDA ARS SEL) for identification confirmation.**

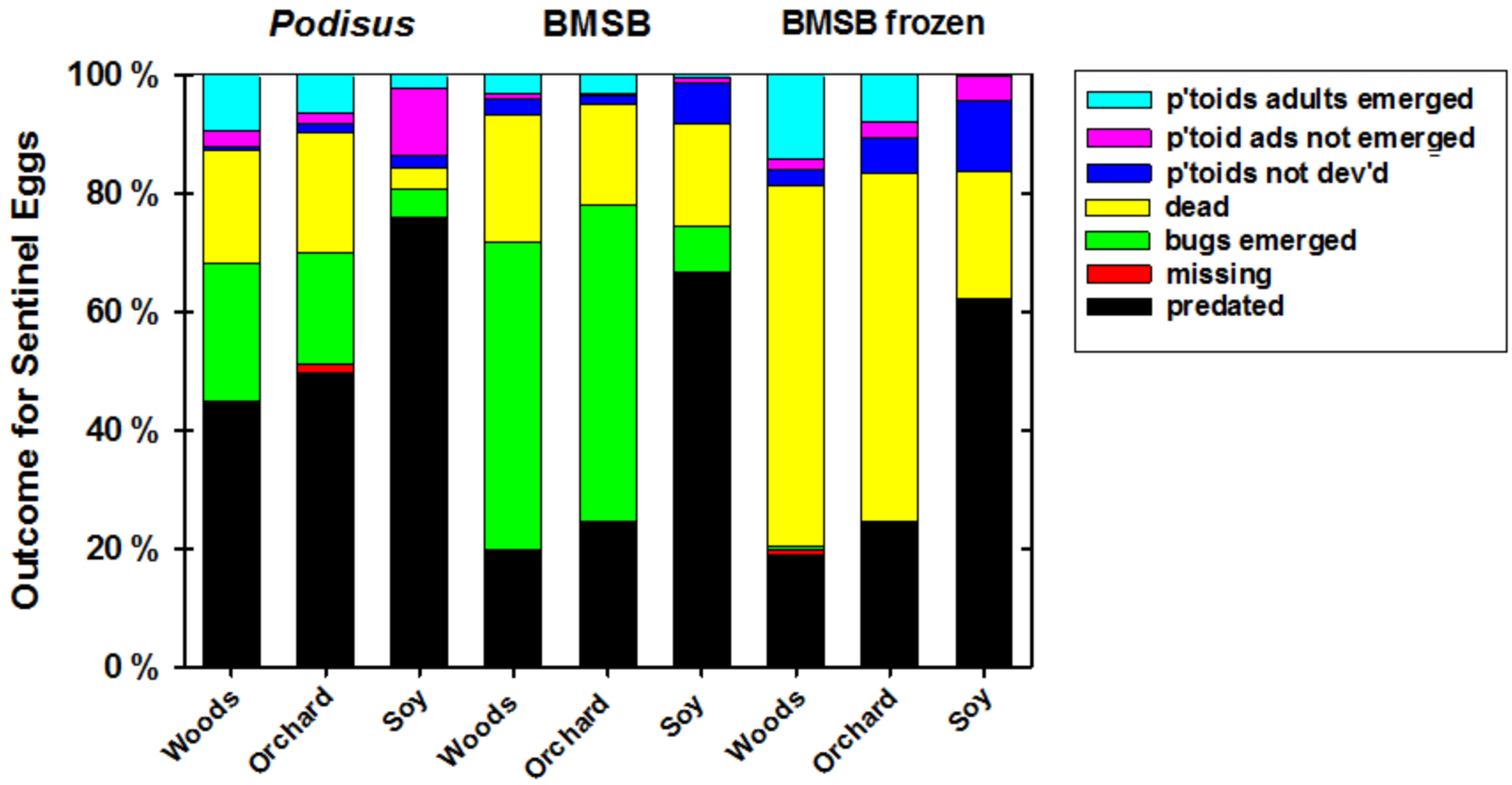


Detection of *Trissolcus japonicus* using sentinel egg masses Beltsville Maryland and vicinity (USDA ARS IIBBL), 2014-15

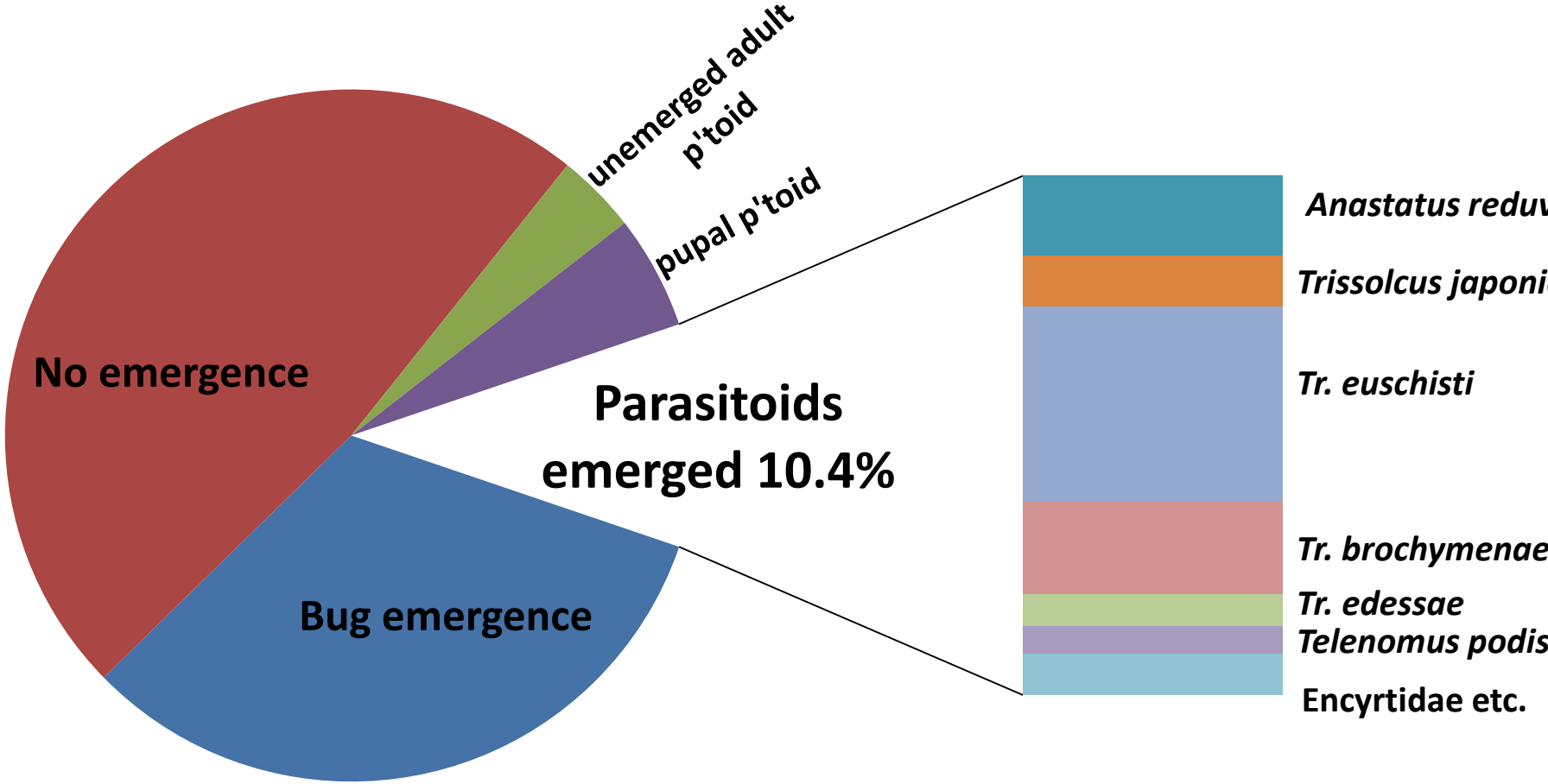


D.Weber 11/8/2015

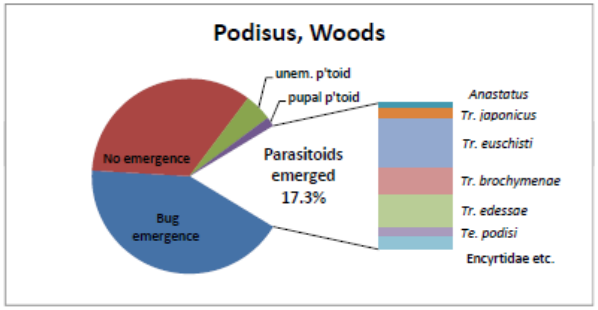
Summary of Sentinel Egg Outcomes by Egg Type and Habitat

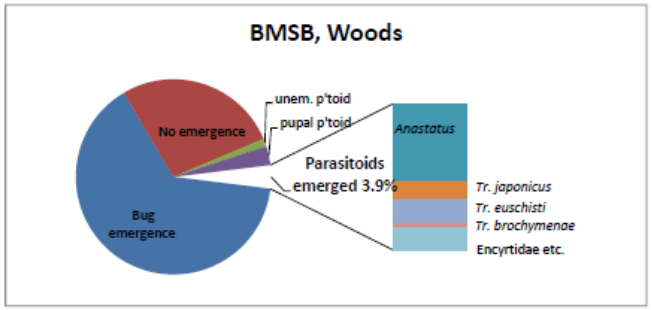


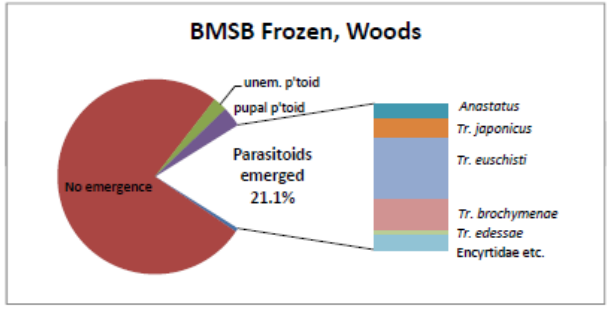
Outcomes after predation, totals for all egg types and habitats

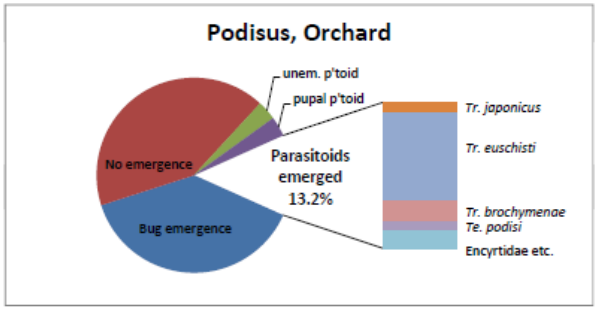


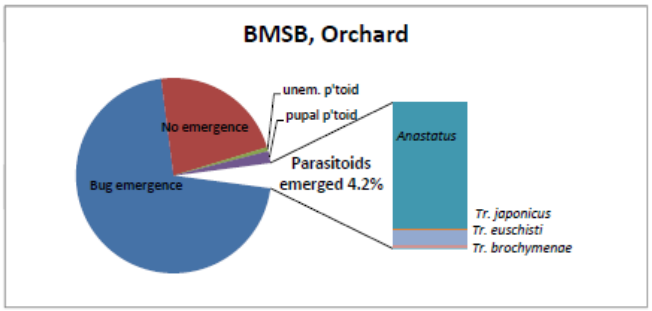
Overview of parasitoids emerged from different egg types and habitats

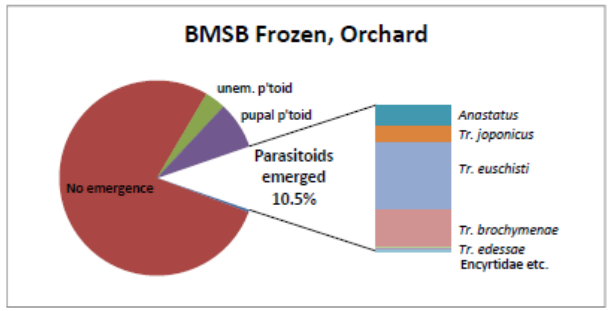


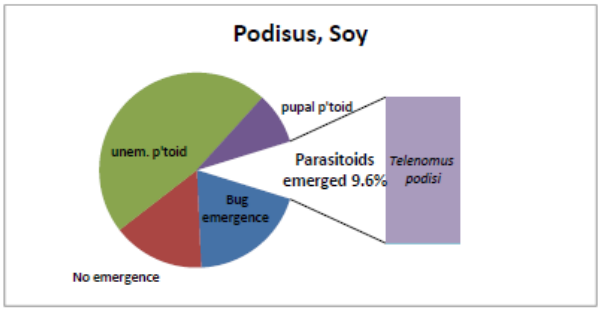


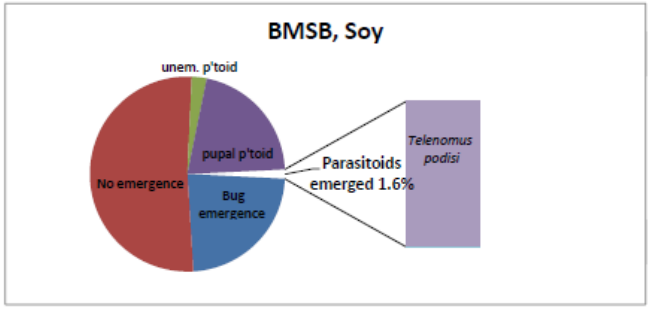


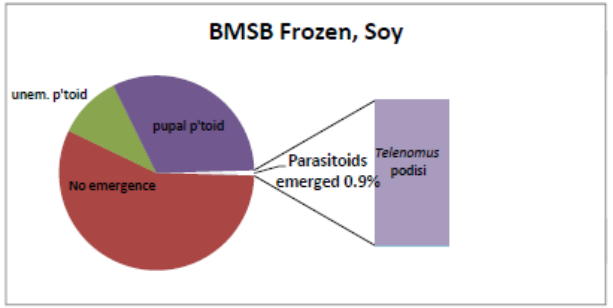






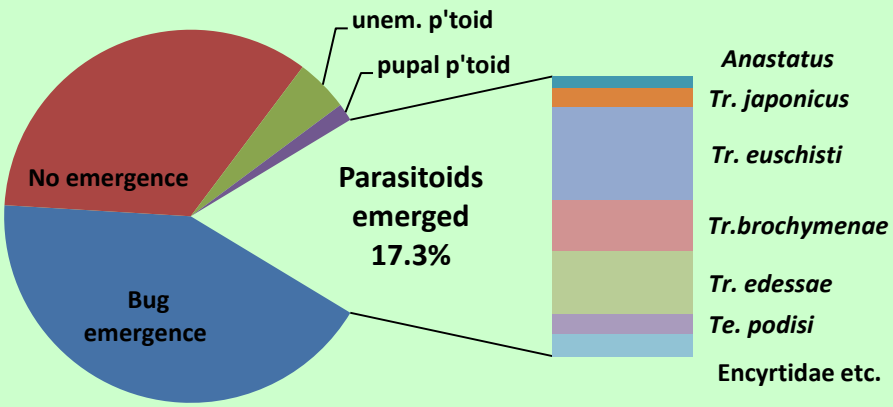




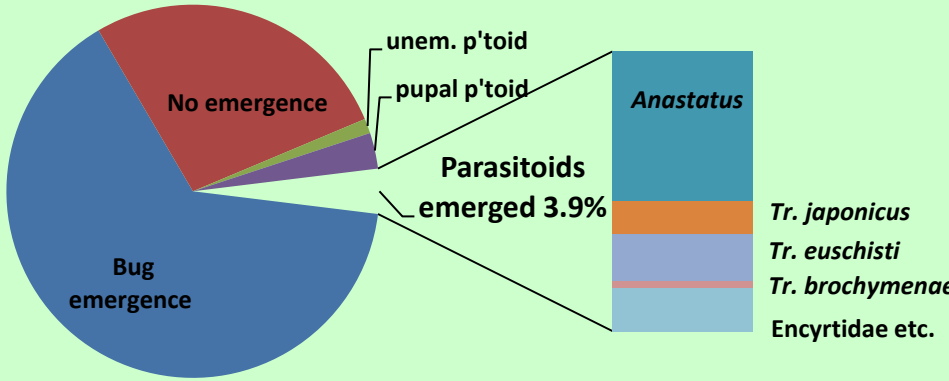


Detail in woods and soy habitats: parasitoids emerged from BMSB and spined soldier bug

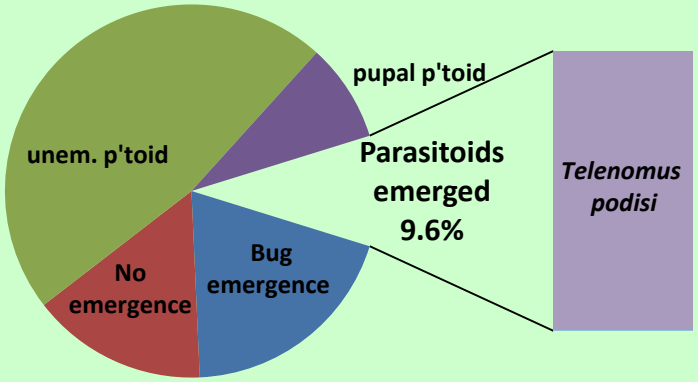
Podisus, Woods



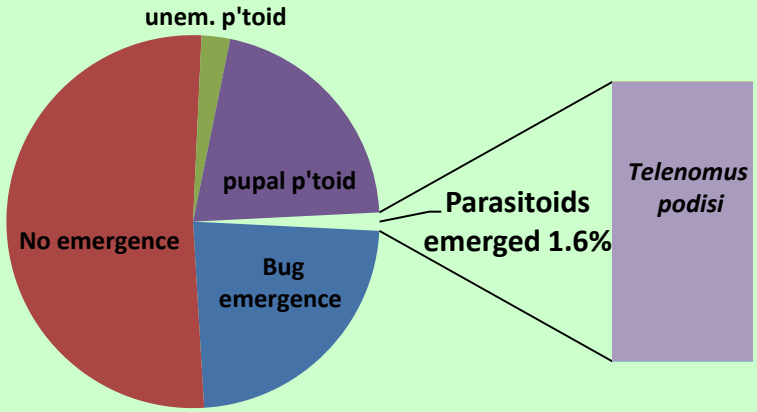
BMSB, Woods



Podisus, Soy



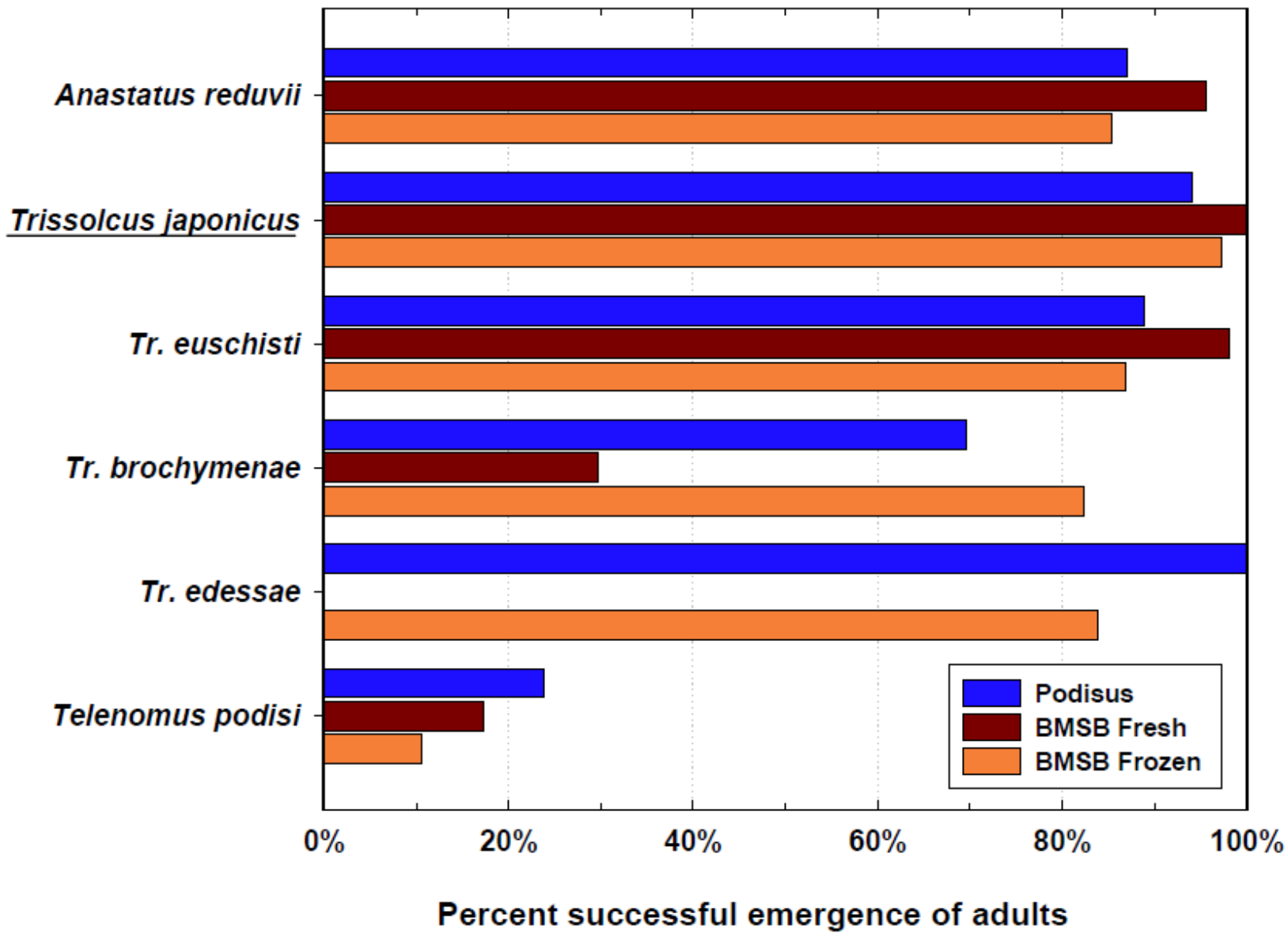
BMSB, Soy



Trissolcus japonicus recoveries

Three sites overall: 1 of 17 wooded sites, 2 of 4 orchard-type sites, and 0 of 4 soybean sites.
Overall low rate of parasitism; no significant difference among egg types (*Podisus* and BMSB).

Habitat & Site	Egg Mass Type	deployed	recovered	para'd by T.j.	% egg masses T.j.	Exact test	number of T.j. emerged	% succ. para'd by T.j.
Woods Central	Podisus	38	27	1	3.7%	NS	1	0.2%
Woods Central	BMSB Fresh	47	41	1	2.4%		1	0.1%
Woods Central	BMSB Frozen	48	39	1	2.6%		18	2.2%
Orchard North	Podisus	38	31	1	3.2%	NS	18	3.0%
Orchard North	BMSB Fresh	47	44	0	0.0%		0	0.0%
Orchard North	BMSB Frozen	48	46	1	2.2%		27	2.5%
Orchard East	Podisus	86	64	2	3.1%	NS	45	3.1%
Orchard East	BMSB Fresh	94	82	2	2.4%		26	1.4%
Orchard East	BMSB Frozen	98	92	8	8.7%		139	6.6%


Anastatus reduvii
Trissolcus japonicus
Tr. euschisti
Tr. brochymenae
Tr. edessae
Telenomus podisi
Podisus
BMSB Fresh
BMSB Frozen
0%
20%
40%
60%
80%
100%
Percent successful emergence of adults

Summary of 2015 Results

- ***Trissolcus japonicus*, adventive from Asia, overwintered successfully.**
- ***T. japonicus* parasitizes BMSB and spined soldier bug sentinel egg masses in the field.**
- **All six major parasitoids show strong habitat specificity, and some of these show host preference as well.**
- **Native parasitoids vary in their ability to successfully develop and emerge from BMSB eggs; some (*Anastatus reduvii* and *Trissolcus euschisti*) often successfully emerge.**
- **Frozen egg masses are helpful in measuring parasitoid oviposition which is unsuccessful on live egg masses.**
- **Predation caused significant mortality to BMSB eggs, especially on sentinels on soybean foliage.**

Parasitoid attack: Multiple Outcomes

- Parasitoid (unsynchronized temporally)
  (not in habitat/plant host)(fails to locate)
- Oviposition with no development; host emergence
- Oviposition with failed development; no host emergence
  - detectable
  - undetectable
- Oviposition with development but emergence unsuccessful
- Oviposition with development, successful emergence, and reproduction

Future research

- **Track the expanding distribution of *T. japonicus*.**
- **Determine the ability of native parasitoids to attack BMSB and non-target eggs in different habitats and locations.**
- **Use sleeve cages on existing vegetation to provide more realistic presentation of eggs to parasitoids in the field.**
- **Determine semiochemical cues that increase or decrease host location and acceptance.**
- **Implement molecular tools to track failed parasitism.**
- **Explore methods to increase native parasitoid success.**

BMSB Biological Control: A changing landscape

- Imbedded in food web of native & exotic plants, stink bugs (and other herbivores) and predators and parasitoids and pathogens and symbionts
- As invasion expands, more novel natural enemies encountered (along with more valuable crops, etc.!)
- All organisms evolving, with strong selective pressure for adaptation to BMSB where it is abundant (soon enough?)

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Acknowledgements

- Emma Thrift, Liz Fread, Abby Rosenberg, and Nate Erwin for their field work and other help!