Natural Enemies: Variation Among Regions and Habitats

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Specialty Crop Research Initiative

Collaborating Institutions

ars · NC State University · PennState · OSU Oregon State University · University of Maryland · University of Georgia · Washington State University · Northeastern IPM Center · Cornell University · Utah State University · Rutgers University · The Ohio State University · University of Kentucky · UC Davis · Virginia Tech · Berkeley · University of Minnesota · Michigan State University · UC Riverside

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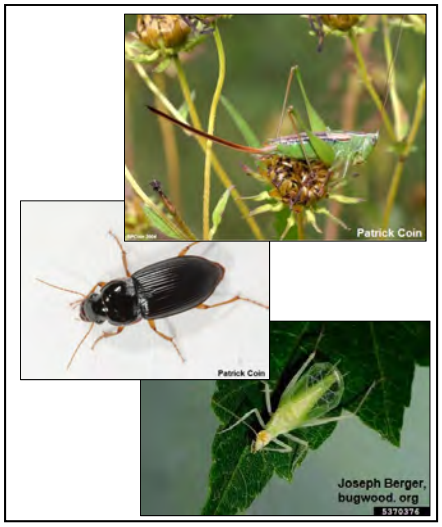
Biological Control Agents

Insects that attack BMSB eggs

Parasitoids

Predators



Project Objectives

Determine regional and habitat differences in parasitoid identity (native and exotic) and the impact of natural enemies (2017, 2018

Maximize impacts of natural enemies across agroecosystems

Participating states within regions

Regions and participating states

Region	State (years)	Collaborators
Mid-Atlantic	Maryland (2017/18)	Paula Shrewsbury, Rebeccah Waterworth
	Delaware (2017/18)	Kim Hoelmer, Kathy Tatman
	Virginia (2017)	Chris Bergh, Nicole Quinn
	Pennsylvania (2017)	Greg Krawczyk
Southeast	Kentucky (2017/18)	Ricardo Bessin, Lauren Fann
	North Carolina (2017/18)	Jim Walgenbach, Emily Ogburn
Pacific NW	Oregon (2017/18)	Nik Wiman, Heather Andrews, David Lowenstein
	Oregon (2017*/18)	Jana Lee, Hanna McIntosh, Gracie Galindo
	Washington State (2017/18)	Betsy Beers, Joshua Milne
West	Utah (2017/18)	Diane Alston, Cody Holthouse, Zach Schumm
Great Lakes	Ohio (2017*/18)	Celeste Welty, Kristina Fox Vik
	Wisconsin (2018)	Janet van Zoeren, Christelle Guedot

* 2017 Data not included yet

Habitat categories and types

Habitat Category:	Habitat Type:
1. Forests	1. Wooded edges
2. Orchards	2. Apple, peach, pear, hazelnut
3. Ornamentals	3. Nurseries, urban landscapes
4. Field/vegetable crops	4. Corn, soybean, peppers
5. Semi-natural	5. Campuses, parks, arboretum
6. Mixed / other	

Project Methods – Sampling site relative to *Tr. japonicus* redistribution

Questions:

Were *Tr. japonicus* released within 2 km of sampling site?

If so, at what rate?

1. **No *Tj* redistribution** = *T. japonicus* was not redistributed in the state or if release points were > 2 km away from native natural enemy survey sites
2. **Low release *Tj*** (1-2 parasitized egg masses)
3. **High release *Tj*** (15-20 parasitized egg masses)

Project Methods - sampling

Sentinel BMSB egg mass

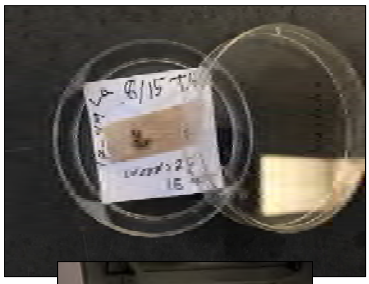
- **Fresh: <24 hr after being laid**
- **Frozen: held at -80°C for less than 6 wk**
- **In the field**
  - **Egg mass pinned to the underside of a host leaf**
  - **Remain in the field for ~3 days**

Naturally-laid BMSB or other stink bug egg masses

Yellow sticky cards

Sampling repeated over time

Project Methods – assessment



In the lab

- **Storage**
- **Parasitoid collection and curation**
- **Egg mass dissections**

Curated parasitoid

From Lara et al. 2016, Photo: S. Triapitsyn

2018 – 2,729 fresh sentinel egg masses

Data collected

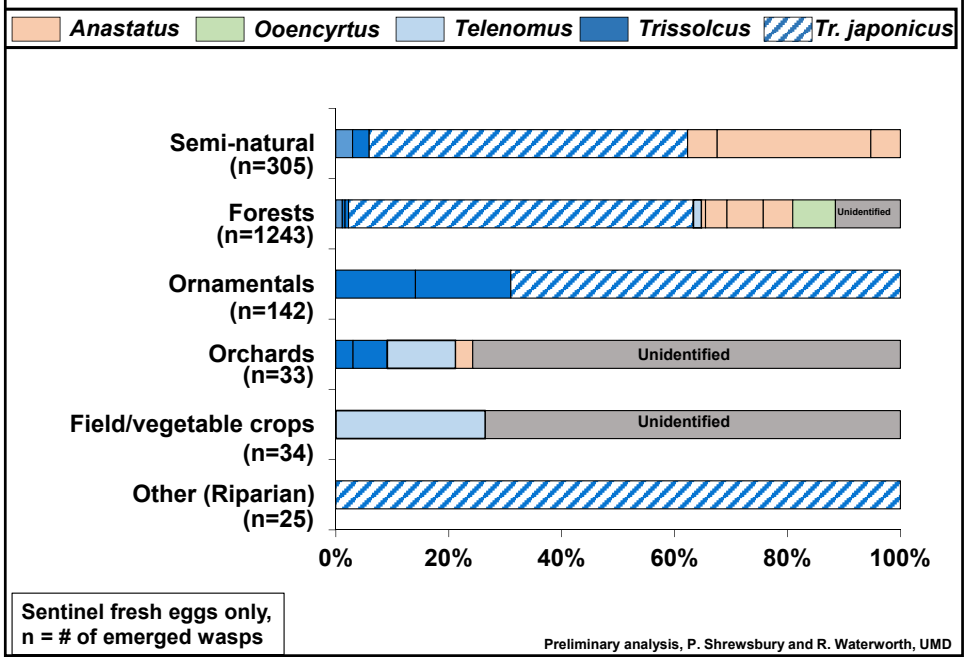
Parasitoid ID

- Native *Trissolcus* spp., *Anastatus* spp., *Telenomus spp.*, *Ooencyrtus*
- Exotic *Tr. japonicus*

Egg fate / mortality factors

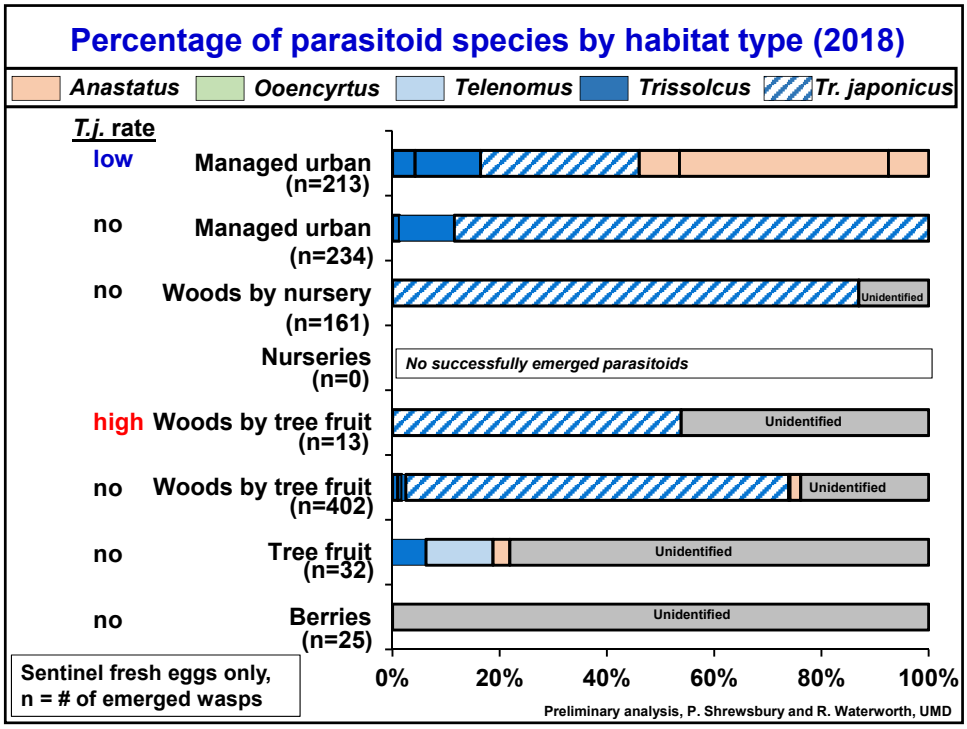
- Parasitism (%)
  - By native or *Tr. japonicus*
- Partial parasitism
  - Unhatched (dissected)
- Predation
  - Chewing (complete, incomplete)
  - Sucking (stylet, punctured)
- Host feeding
- Unascribed / unknown
- Missing (abiotic)
- Hatched BMSB, unhatched BMSB

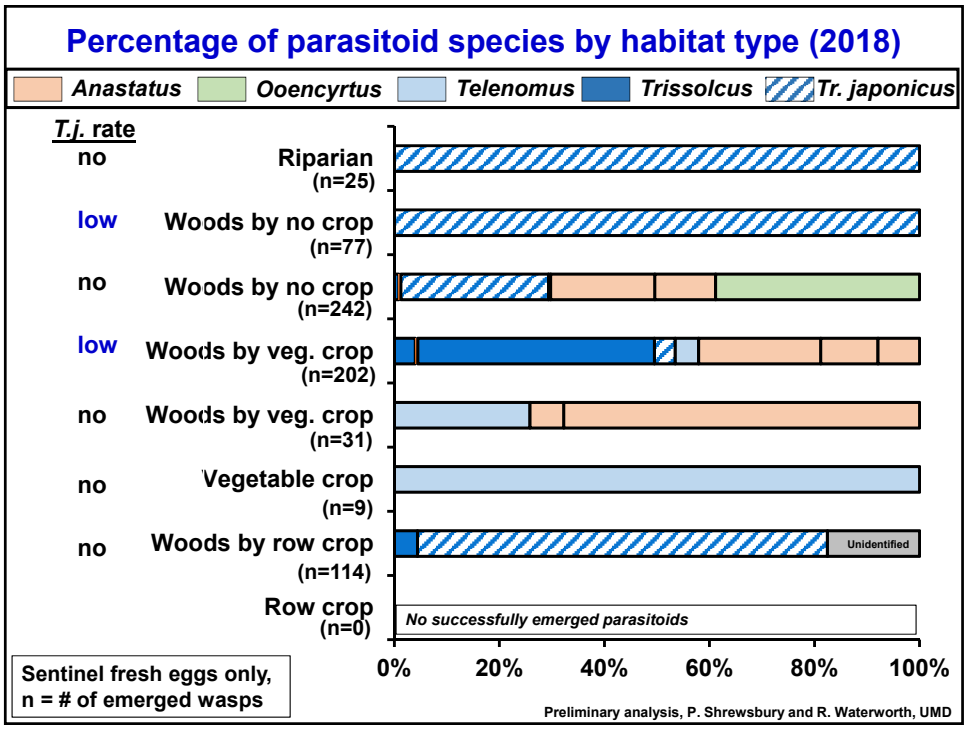
Percentage of parasitoid species by habitat category (2018)

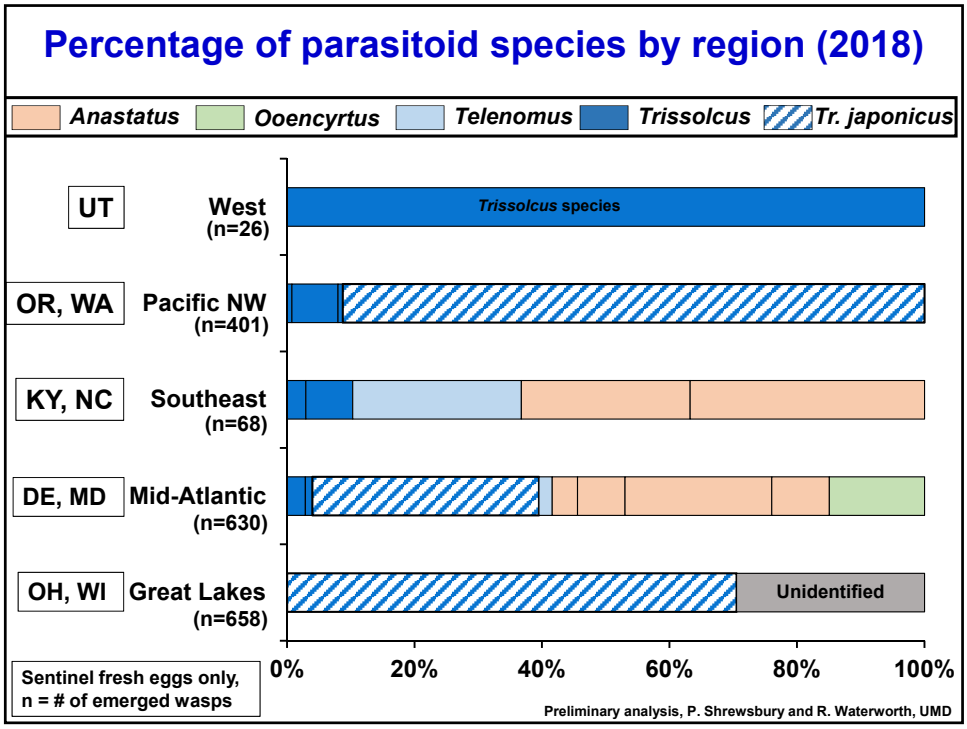


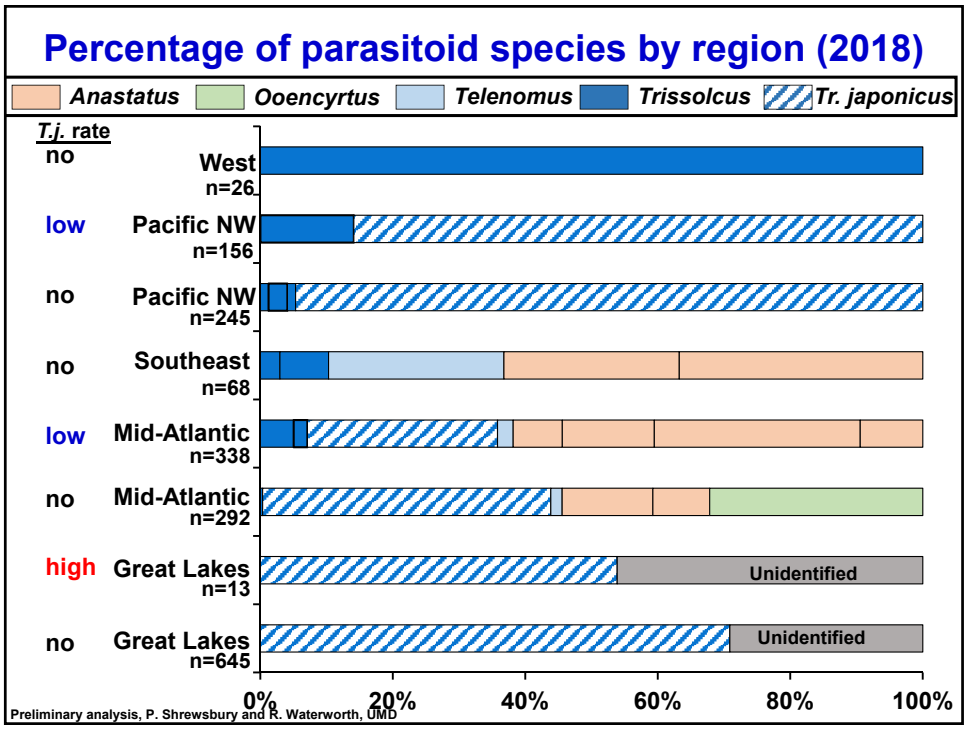
Sentinel fresh eggs only, n = # of emerged wasps

Preliminary analysis, P. Shrewsbury and R. Waterworth, UMD

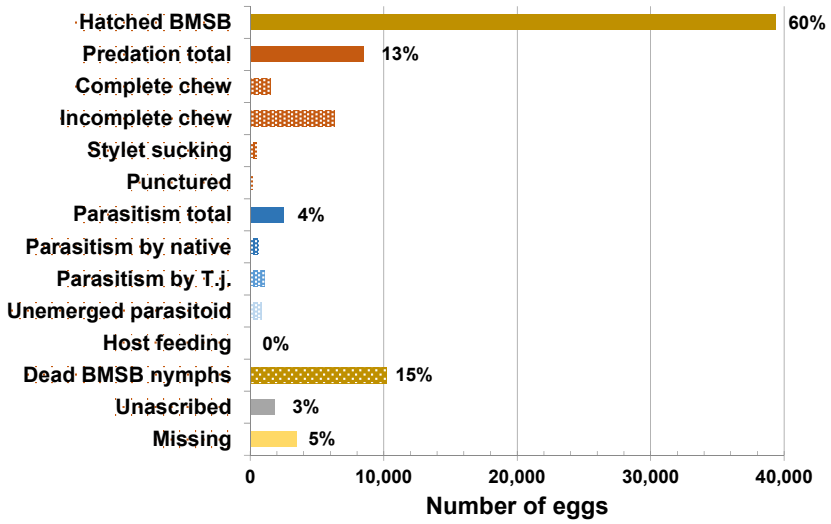

Percentage of parasitoid species by habitat type (2018)
Anastatus
Ooencyrtus
Telenomus
Trissolcus
Tr. japonicus
T.j. rate
low
Managed urban (n=213)
no
Managed urban (n=234)
no
Woods by nursery (n=161)
Unidentified
Nurseries (n=0)
No successfully emerged parasitoids
high
Woods by tree fruit (n=13)
Unidentified
no
Woods by tree fruit (n=402)
Unidentified
no
Tree fruit (n=32)
Unidentified
no
Berries (n=25)
Unidentified
0%
20%
40%
60%
80%
100%
Sentinel fresh eggs only, n = # of emerged wasps
Preliminary analysis, P. Shrewsbury and R. Waterworth, UMD


Percentage of parasitoid species by habitat type (2018)
Anastatus
Ooencyrtus
Telenomus
Trissolcus
Tr. japonicus
T.j. rate
no
Riparian (n=25)
low
Woods by no crop (n=77)
no
Woods by no crop (n=242)
low
Woods by veg. crop (n=202)
no
Woods by veg. crop (n=31)
no
Vegetable crop (n=9)
no
Woods by row crop (n=114)
Unidentified
Row crop (n=0)
No successfully emerged parasitoids
0%
20%
40%
60%
80%
100%
Sentinel fresh eggs only, n = # of emerged wasps
Preliminary analysis, P. Shrewsbury and R. Waterworth, UMD


Percentage of parasitoid species by region (2018)
Anastatus
Ooencyrtus
Telenomus
Trissolcus
Tr. japonicus
UT
West
(n=26)
Trissolcus species
OR, WA
Pacific NW
(n=401)
KY, NC
Southeast
(n=68)
DE, MD
Mid-Atlantic
(n=630)
OH, WI
Great Lakes
(n=658)
Unidentified
0%
20%
40%
60%
80%
100%
Sentinel fresh eggs only,
n = # of emerged wasps
Preliminary analysis, P. Shrewsbury and R. Waterworth, UMD


Percentage of parasitoid species by region (2018)
Anastatus
Ooencyrtus
Telenomus
Trissolcus
Tr. japonicus
T.j. rate
no
West
n=26
low
Pacific NW
n=156
no
Pacific NW
n=245
no
Southeast
n=68
low
Mid-Atlantic
n=338
no
Mid-Atlantic
n=292
high
Great Lakes
n=13
Unidentified
no
Great Lakes
n=645
Unidentified
0%
20%
40%
60%
80%
100%
Preliminary analysis, P. Shrewsbury and R. Waterworth, UMD

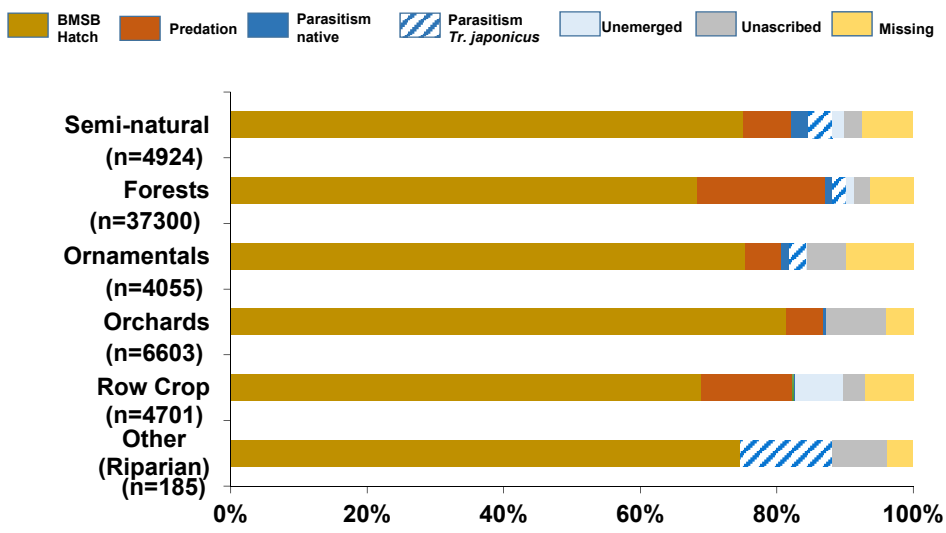
Egg fate – pooled across region and habitat (2018)



Sentinel fresh eggs only
(from 2,729 egg masses total)

Preliminary analysis, P. Shrewsbury and R. Waterworth, UMD

Egg fate by habitat, pooled across regions (2018)



Sentinel fresh eggs only,
n = # of eggs

Preliminary analysis, P. Shrewsbury and R. Waterworth, UMD

Conclusions

Parasitoid taxa

- Habitat
  - Certain parasitoid species are more prevalent in specific habitats (2017 and 2018)
    - *Anastatus* and *Trissolcus* are arboreal
      - *Anastatus* in semi-natural and forests, to lesser extent orchards
      - *Trissolcus* in all habitats except veg / field crops
    - *Telenomus* (2017, 2018) and *Ooencyrtus* (2018) in veg / field crop only
  - Patterns similar in 2017 and 2018, but greater abundance of *Tr. Japonicus* in 2018; patterns similar to earlier studies
  - Association with *Tr. japonicus* releases do not to consistently influence the abundance of *Tr. japonicus* (more time)
- Region
    - Certain parasitoid species were only found in specific regions
    - Mid-Atlantic had the greatest diversity of parasitoid species
    - Association with *Tr. japonicus* releases do not consistently influence the abundance of *Tr. japonicus*

Conclusions (con't)

Impact by parasitoids and predators

- Overall
  - There was low overall impact of parasitoids (4%) and predators (13%), slightly lower than 2017
- Habitat
  - Predation was greatest in forests (wooded areas), followed row crops
  - Parasitism was similar for semi-natural, forests, and ornamentals
  - Parasitism was lowest in row crops and orchards

Future efforts

- Incorporate additional data (fresh sentinel eggs and other sampling methods), and analyze 2017 and 2018 data together to elucidate more robust patterns
- Discuss measures to maximize biological control