

Biological Control of Brown Marmorated Stink Bug, *Halyomorpha halys* Stål (Hemiptera: Pentatomidae) in NYS



Photograph: Elijah J. Talamas, ARS USDA.



Photograph: Christopher Hedstrom
USDA-APHIS Quarantine Facility,
Corvallis, Oregon

Dana Acimovic
CALs – HVRL

Art Agnello
CALs - NYSAES

Tessa Grasswitz
CCE-LOFT

Lydia Brown
CALs – HVRL

Peter Jentsch
CALs - HVRL

**Red Tomato Annual Growers Meeting
March 1, 2019
Henry A. Wallace Center, Hyde Park, NY**



Cornell University

Hudson Valley Research Laboratory

brown marmorated stink bug
Halyomorpha halys (Stal)

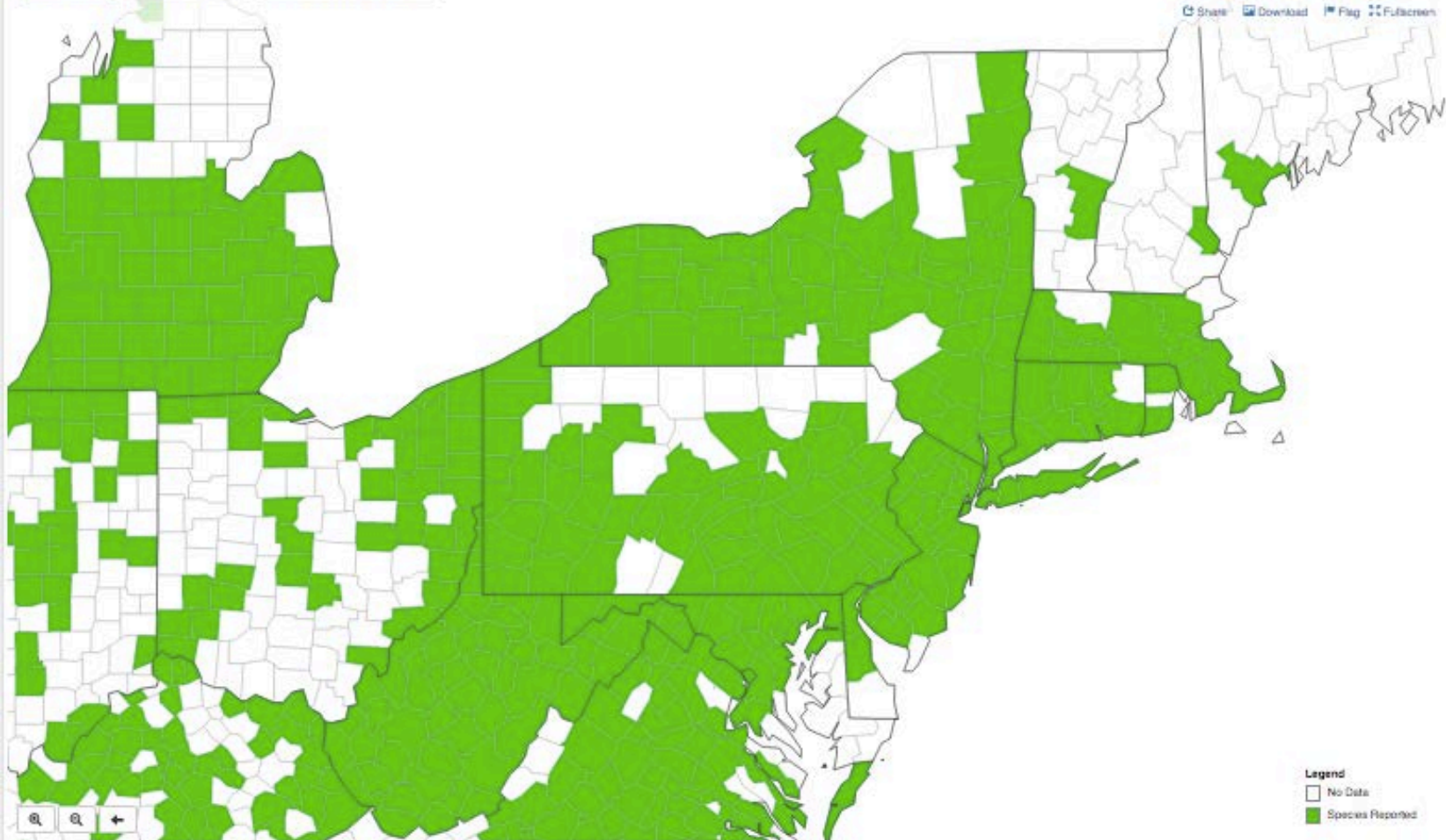
Species Information

States **Counties** Points List

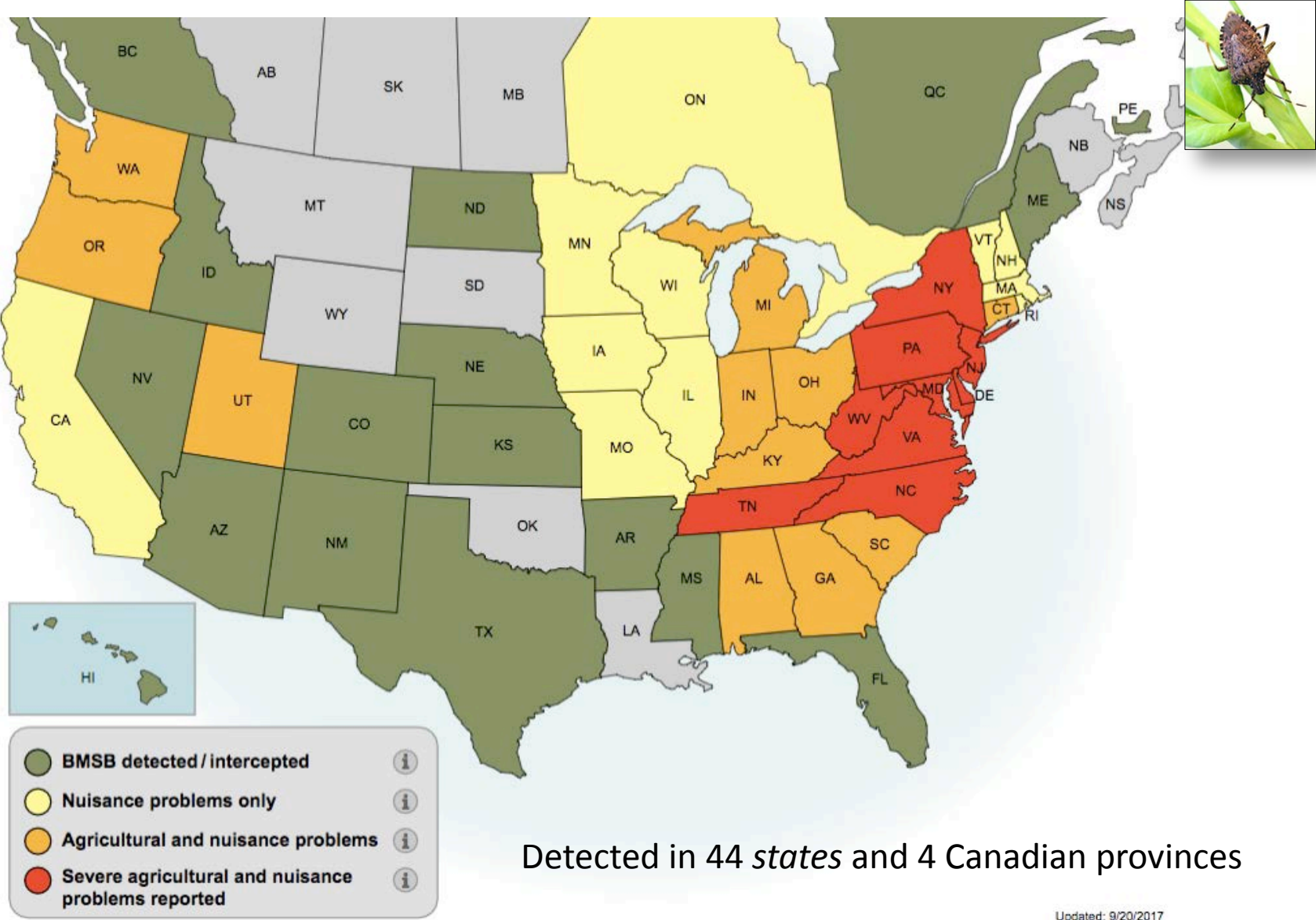
Detected in all but 6 of 62 counties in NYS

Distribution Record Density Literature vs Observation

CSV KML GPX Shapefile
Share Download Flag Fullscreen



The Brown Marmorated Stink Bug in the Ag. & Urban Environment



Stink Bug Management



- Late Season Presence
- Perimeter Pest
- Elusive, Unpredictable
- Mid-August to EOS
- 2 Generations / season
- Economic Injury
- High Value Crops
- MRL's / Drought
- Mgt. DTH >7d
- Injury after 14d

Samurai Wasp, Trissolcus japonicus (Ashmead) In NYS



- **Samurai wasp, *Trissolcus japonicus*, is an egg parasitoid of the BMSB**
- **Lays 1 egg into each BMSB egg**
- **Wasp larva feed on BMSB nymph**
- **Adult wasp emerges from BMSB eggs**
- **Can have 5 generations / year**
- **Live along the wooded edge of Ag.**
- **Kills 60-90% of BMSB eggs in Asia.**
- **High probability of success in the US.**



Samurai Wasp, *Trissolcus japonicus* (Ashmead) In NYS



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• **Live along the wooded edge of Ag.**

Resides in BMSB deciduous tree hosts



Introduction to *Trissolcus japonicus* (Samurai Wasp) For BMSB Management ?



Trissolcus japonicus

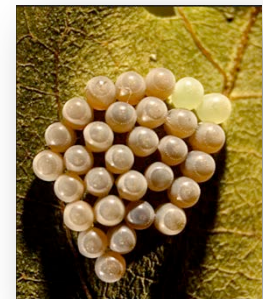
Field Recovery Sites in the US



- In 2014 **adventive** populations (wild) of *T. japonicus* were found in Beltsville, MD using sentinel BMSB eggs

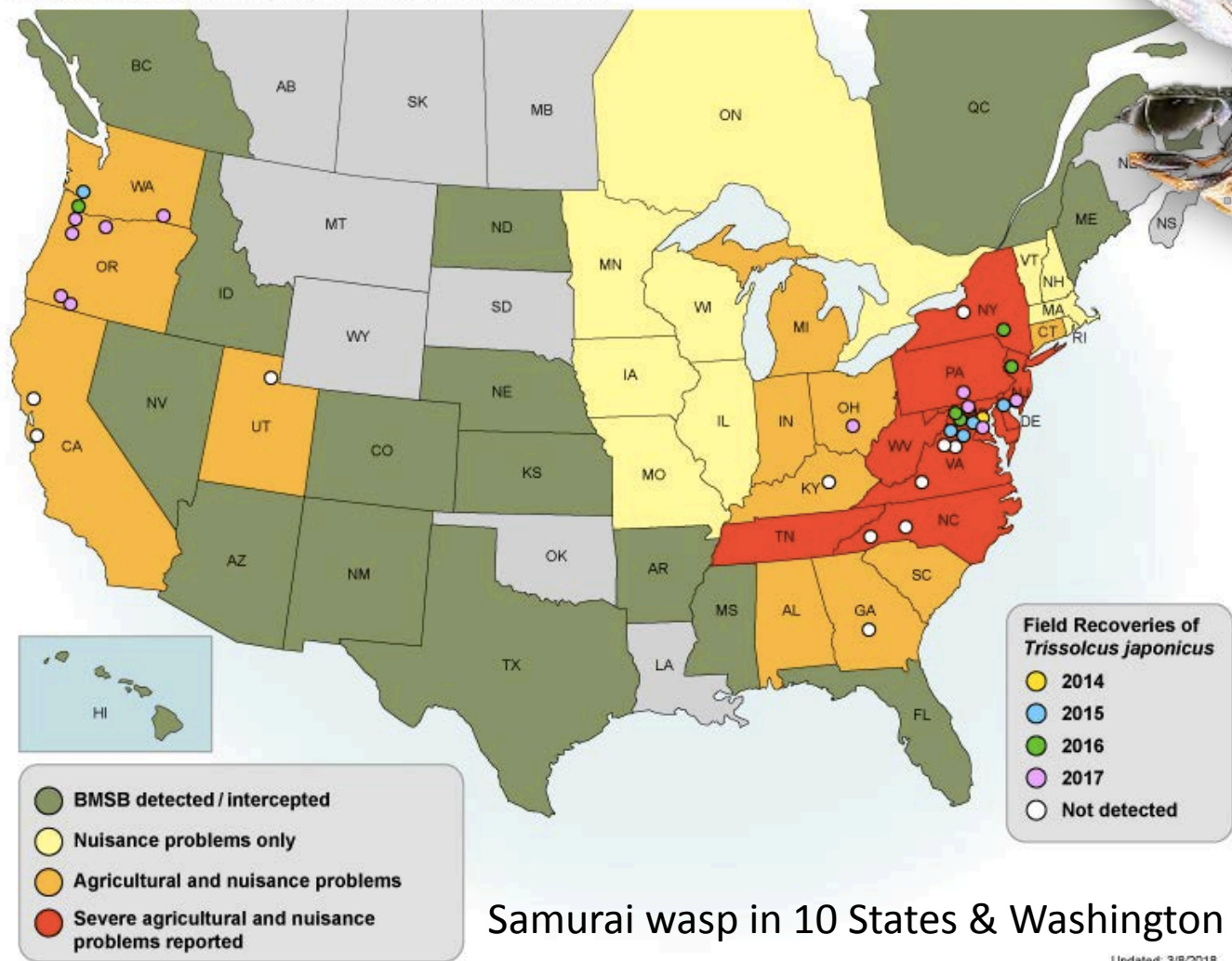
(Talamas EJ, Herlihy MV, Dieckhoff C, Hoelmer KA, Buffington ML, Bon M-C, Weber DC (2015) *Trissolcus japonicus* (Ashmead) emerges in North America. Journal of Hymenoptera Research 43: 119-128.
<https://doi.org/10.3897/JHR.43.4661>)

- In 2015 *T. japonicus* were found in Vancouver, WA, Washington DC and Winchester, VA,.
- In 2016, *T. japonicus* was also found in WV, MD, NJ and NY in the East, and OR in the West.



Trissolcus japonicus Field Recovery Sites in the US

U.S. Map of Field Recoveries of *Trissolcus japonicus*



Samurai wasp in 10 States & Washington DC by 2017.

Updated: 3/6/2018



NYS DEC Liberation of Wildlife Permit (July 2017)

After in-depth review of applicable provisions of the Environmental Conservation Law (ECL) and Codes, Rules and Regulations of the State of New York (NYCRR), **DEC has concluded that its regulatory authority extends to the issuance of permits for the release of specifically defined species of wildlife and listed endangered, threatened, and/or invasive species.** Wildlife is defined in ECL S 1 1-0103. Endangered and threatened species are identified in 6 NYCRR Part 182, and listed **invasive species are identified in 6 NYCRR Part 575.**

DEC has recently concluded that their statutory and regulatory framework around the Liberation of Wildlife Permit regulating release of biologicals such as insects does not generally apply to releasing insects into the wild, so long as the proposed release is not of an insect that is listed on either the endangered or invasive species listings.

Upon review by the DEC, the adventive *T. japonicus* population does not require a license or permit from DEC to undertake the movement and release of the Samurai wasp, as it is not listed within 6 NYCRR 575.





Baseline Sentinel *H. halys* Egg Survey Placement Sites in NYS 2017 (6 Counties, 11 sites, 3-24 clusters/site/wk. N=2700 sentinel eggs, 7 plant hosts)

Schutt Orchard	Webster	Monroe	Acer saccharum, (sugar maple)	43°11'3.78"N	77° 26' 56.76"W
Windmill Orchard	Ontario	Ontario	Acer saccharum, (sugar maple)	43°15'50.27"N	77° 22' 35.32"W
Wooded	Holley	Orleans	Juglans nigra (Black Walnut)	43° 13' 59.52"N	78° 18' 7.27"W
Wooded	Lyndonville	Orleans	Malus spp. (crab apple)	43° 19' 38.28"N	78° 19' 33.96"W
Wooded	Medina	Orleans	Ailanthus altissima (Tree of Heaven)	43°12'1.79"N	78° 23' 36.81"W
Partyka Farms	Kendall	Orleans	Fraxinus americana (White Ash)	43°19'8.34"N	77°59'33.72"W
KM Davies	Williamson	Wayne	Acer saccharum, (sugar maple)	43°14'10.54"N	77 °11' 23.63"W
Hepworth Farms	Marlboro	Ulster	Robinia pseudoacacia (Black Locust)	41°40'14.72"N	74° 5' 11.21"W
Hepworth Farms	Marlboro	Ulster	Ailanthus altissima (Tree of Heaven)	41°40'14.72"N	74° 5' 11.21"W
Minard Orchard	New Paltz	Ulster	Vitis spp. (wild grape)	41°42'1.47"N	74° 4' 24.13"W
Crist Orchard	Walden	Orange	Ailanthus altissima (Tree of Heaven)	41°33'2.64"N	74° 9' 50.72"W



2017 *H. halys* -80°C Sentinel Egg Deployment



NY State-wide survey for parasitoids

- Used -80°C frozen sentinel eggs on Jalapeno leaves were attached to BMSB host foliage.
- 11 sentinel sites in 6 Counties
- 7 WNY and 4 ENY sites.
- 3 clusters/site/wk. on 10 Farms in 6 Counties
≈2700 sentinel eggs, 7 plant host
- **Weekly June 23th – Oct. 3rd**



2017 *H. halys* -80°C Sentinel Egg Deployment



- Recollection of eggs after 5-7d
- Reared at the HVRL, placed in petri dishes and held in a controlled environment chamber at 25 ° C. / 70°rH
- Eggs were monitored for parasitoid emergence identified by E. Talamas.
- Adults parasitoids reared from sentinel egg masses given a 90% honey-water solution 1 uL droplets on dish



Expanding the Range of the Parasitoid Wasp, *Trissolcus japonicus*, (Hymenoptera: Scelionidae) in NYS.

2017 Sentinel Egg Emergence

Native

Trissolcus euschisti (6/23)

N=1 Marlboro, Ulster Co.

Telenomus podisi (6/30, 8/24)

N=3 Marlboro, Ulster Co.

N=2 Kendall, Monroe Co.

N=1 Medina, Orleans Co.

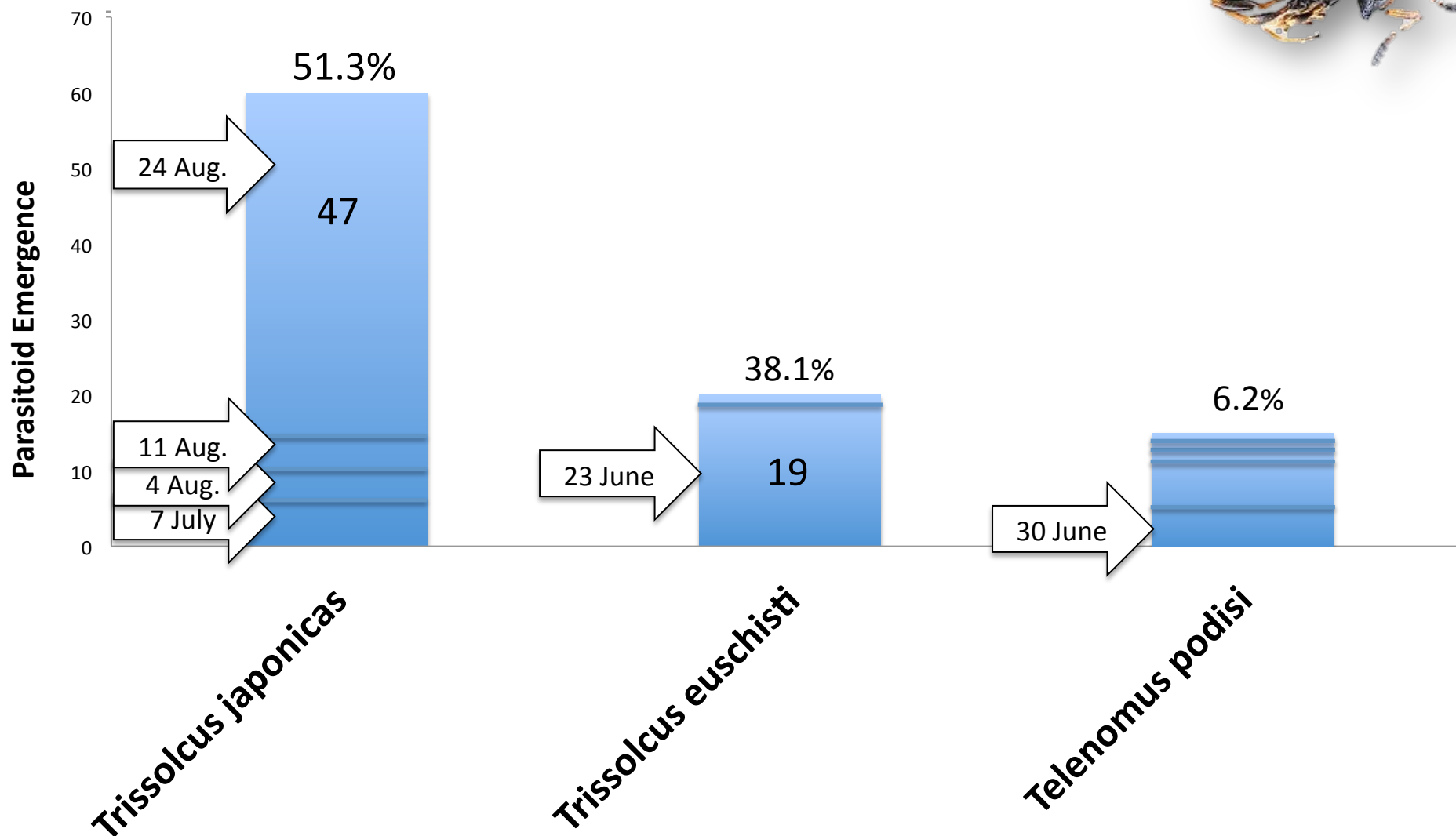
Asian Invasive

Trissolcus japonicus (7/7, 8/4, 8/11)

N=60 Marlboro, Ulster Co.



**Parasitoid Survey:
Seasonal Emergence from BMSB -80°C Frozen Eggs
23rd June - Aug. 24th Marlboro, NY 2017**



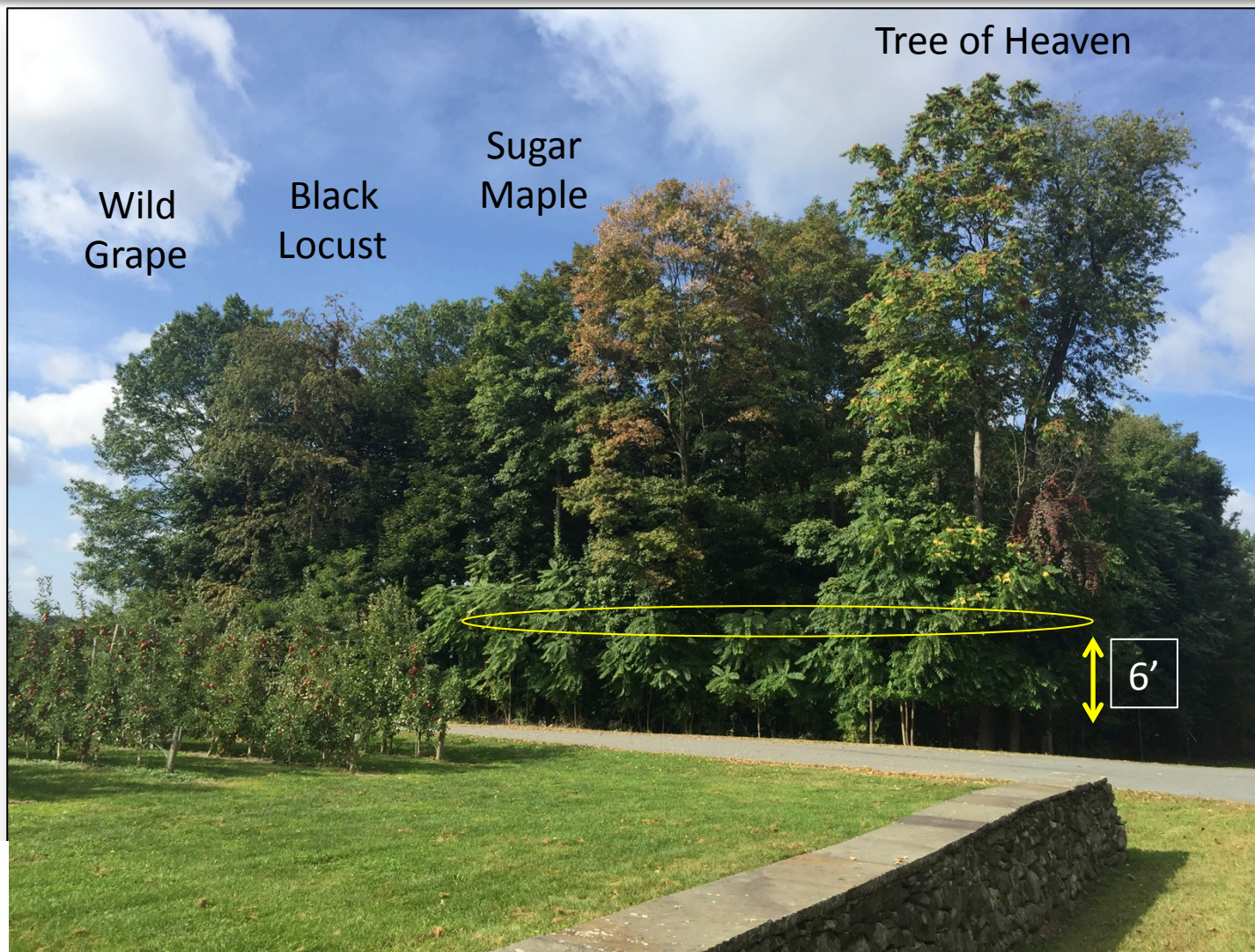
2017 Parasitized Egg Parasitoid Release 'Redistribution'



- Marlboro *T. japonicus* used to develop colony and parasitize -80°C BMSB eggs.
- Fixed parasitized eggs to petri dish lid added zip tie for RT mailing and emergence.
- Parasitized eggs sent to cooperators on **15th September**.
- Parasitized eggs placed on 32 sites of 25 farms in 5 NY counties.



Brown Marmorated Stink Bug: Biological Control Release Sites



Expanding the Range of the Parasitoid Wasp, *Trissolcus japonicus*, (Hymenoptera: Scelionidae) in NYS.

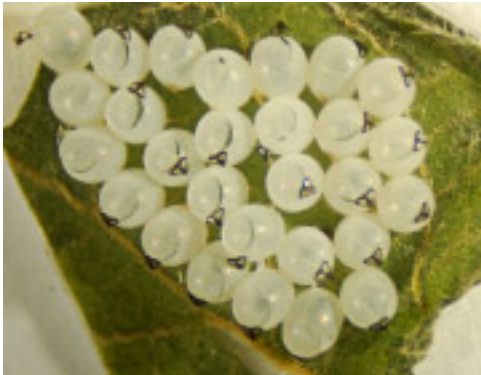


Recollection of Parasitized Eggs

- 168 or 23.4% (N=719) successfully emerge as adults
- 0.7% partially emerged from the egg
- 76.4% of the eggs showing no sign of emergence; majority of eggs were parasitized and unsuccessful in development.



Expanding the Range of the Parasitoid Wasp, *Trissolcus japonicus*, (Hymenoptera: Scelionidae) in NYS.



Normal, hatched BMSB egg mass.



BMSB eggs showing damage from sucking predators.



BMSB eggs showing damage from chewing predators.



*Spined soldier bug
*Podisus maculiventris**

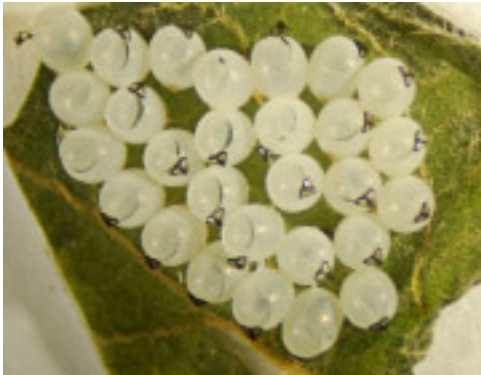


Native Predatory feeding and Parasitism

- Predatory feeding accounts for up to 20% reduction of BMSB egg loss.



Expanding the Range of the Parasitoid Wasp, *Trissolcus japonicus*, (Hymenoptera: Scelionidae) in NYS.



Normal, hatched BMSB egg mass.



Parasitized BMSB eggs.

Native Predatory feeding and Parasitism

- Parasitism by native accounts for < 1% to 5% dependent on habitat.



Trissolcus brochymenae



Telenomus podisi

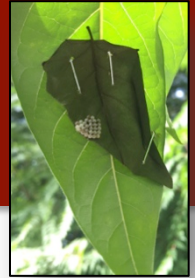


Anastatus reduvii





Redistribution Site Confirmation of Samurai Wasp Using Post Emergence Sentinel Eggs*



- Upon emergence, sentinel eggs were placed 30 meters from *T. japonicus* in two of the release sites .
- Egg parasitism by *T. japonicus* was observed in these release sites from 15th September to 3rd October.

2017	Trissolcus japonicas	Trissolcus euschisti	Telenomus podisi	WNY County
24-Aug	0	0	2	Kendall, Monroe Co.
15-Sep	2	0	0	Webster, Wayne Co.
22-Sep	0	0	1	Medina, Orleans Co.
22-Sep	3	0	0	Webster, Wayne Co.
29-Sep	1	0	0	Webster, Wayne Co.
18-Oct	1	0	0	Holly, Orleans County



“Woe is me! for I am undone”

Isaiah 6:5 KJV

2018 Spring & Summer Season

BMSB Overwintering, Spring and Summer Egg Production

- Low colony levels
- Balance maintaining T.j. colony / with BMSB development to August.



“Woe is me! for I am undone”

Isaiah 6:5 KJV

2018 Spring & Summer Season

BMSB Overwintering, Spring and Summer Egg Production

- Low early season colony levels; few eggs produced
- Balance maintaining *T.japonicus* colony / with BMSB colony development to August.

Very high microsporidia levels were found the HVRL colony & in wild caught overwintering emerging populations from the field



HVRL BMSB Colony Microsporidia Infection Rates



* Carrie Preston – Hajek A.E. Lab, Cornell Univ.



I. Sentinel Egg Survey June 23rd – Sept. 15th

- Weekly sentinel egg placement of 2 clusters / site
- Used 9 representative redistribution sites (2017)
- No *T.j.* recovered from original Marlboro site
- No *T.j.* recovered from 9 representative release sites



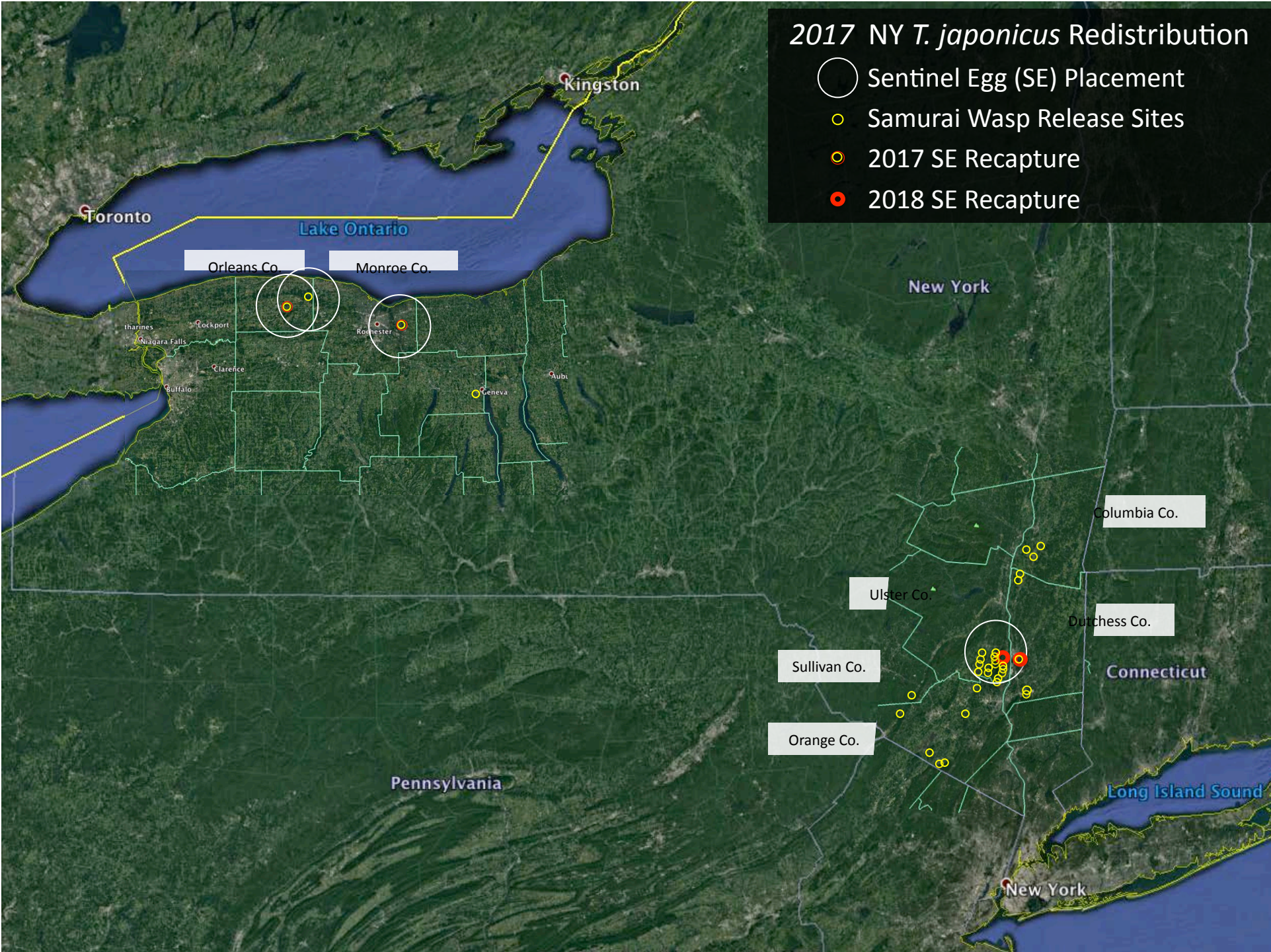
II. Alpha Scent Yellow Sticky Cards

- 2 cards in each of 9 sites replaced every 2 weeks
- Captured native parasitoids: *T. euchesti* & *T. podesi*
- (1) *T.japonicus* recovered in Poughkeepsie, Dutchess Co.
- (1) *T.j.* in KM Davis Holly, Orleans Co.



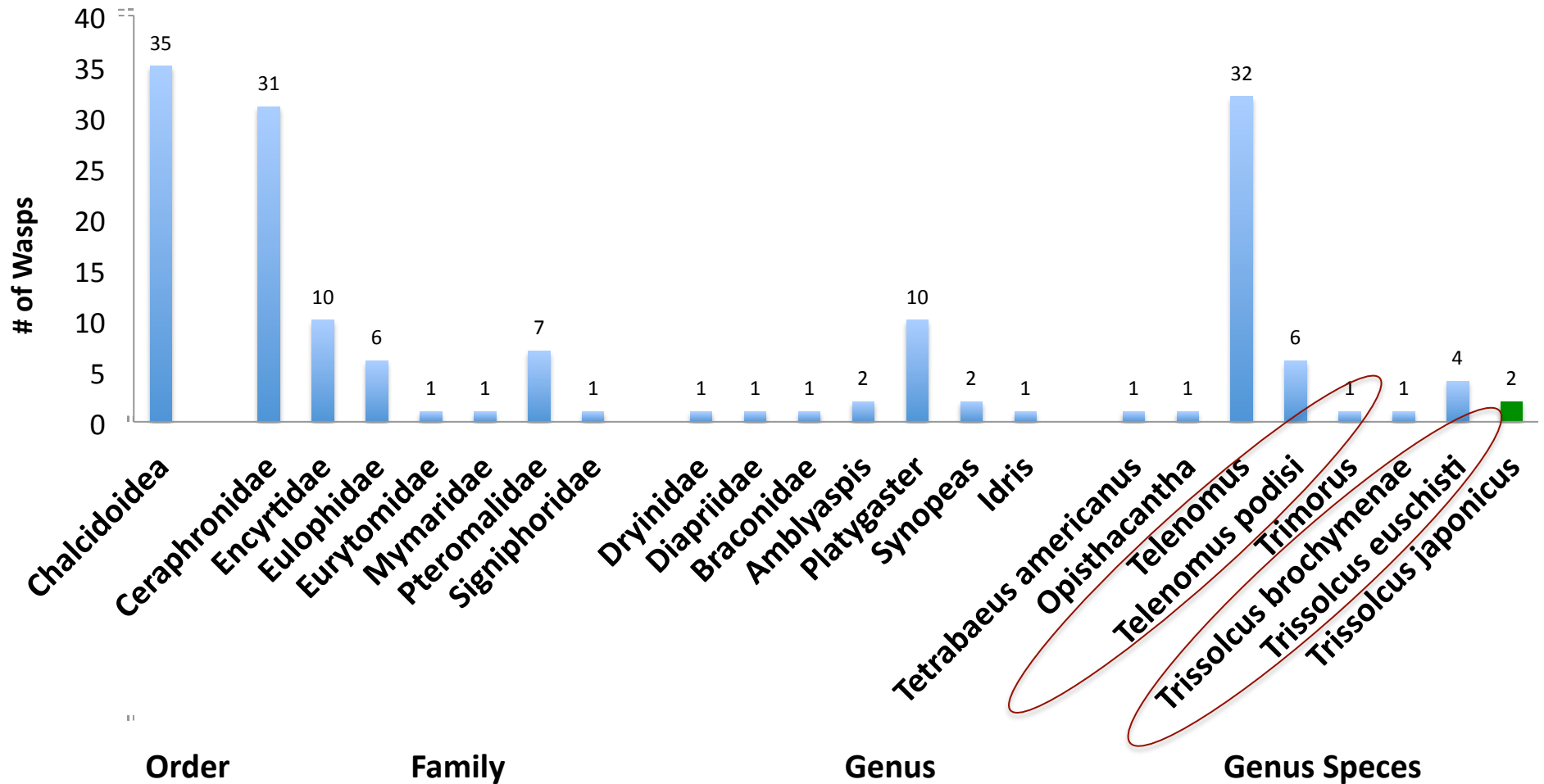
2017 NY *T. japonicus* Redistribution

- Sentinel Egg (SE) Placement
- Samurai Wasp Release Sites
- 2017 SE Recapture
- 2018 SE Recapture



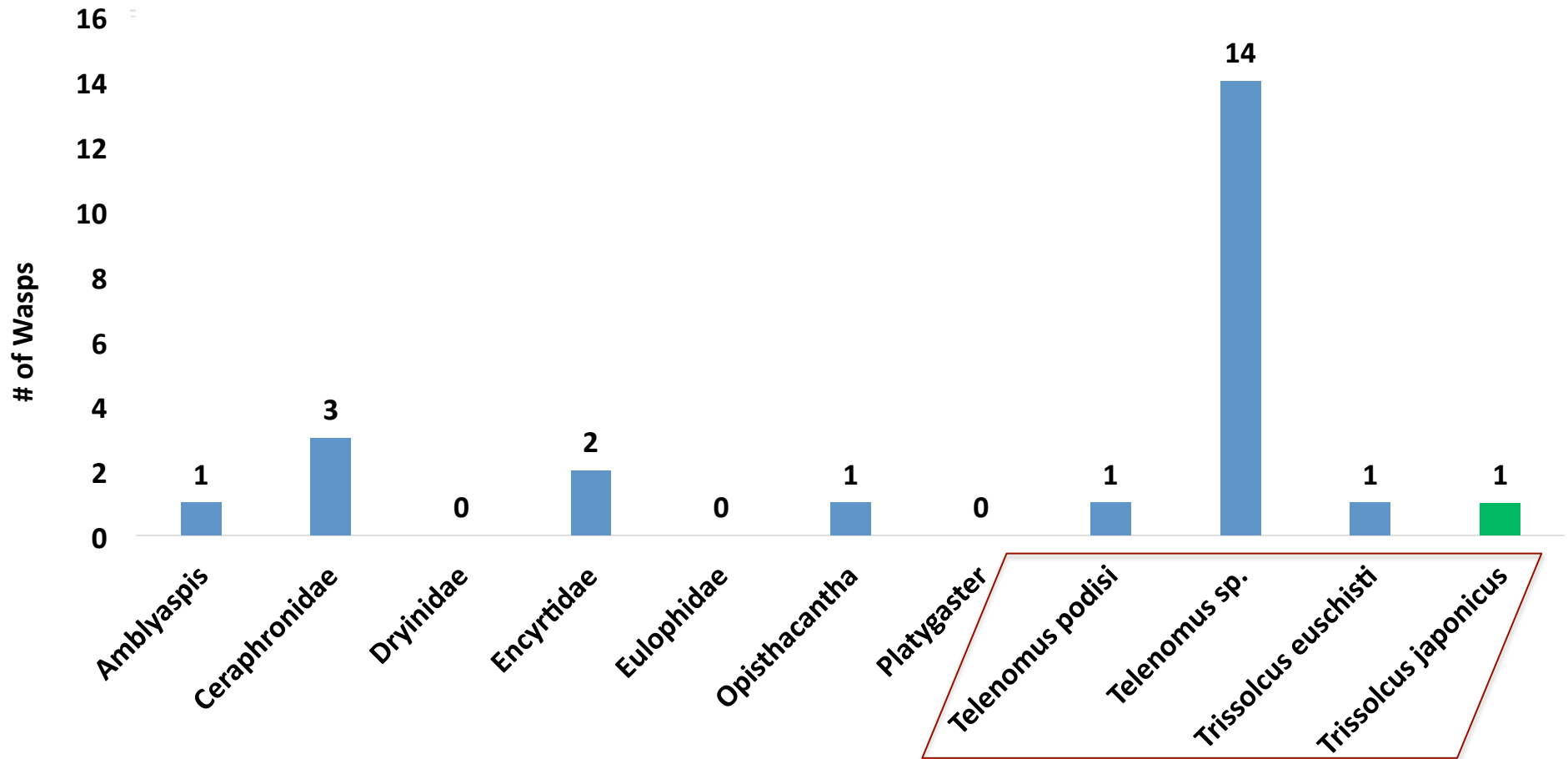
NYS Parasitoid Survey Using Alpha Scent Cards

Hymenopteran Diversity



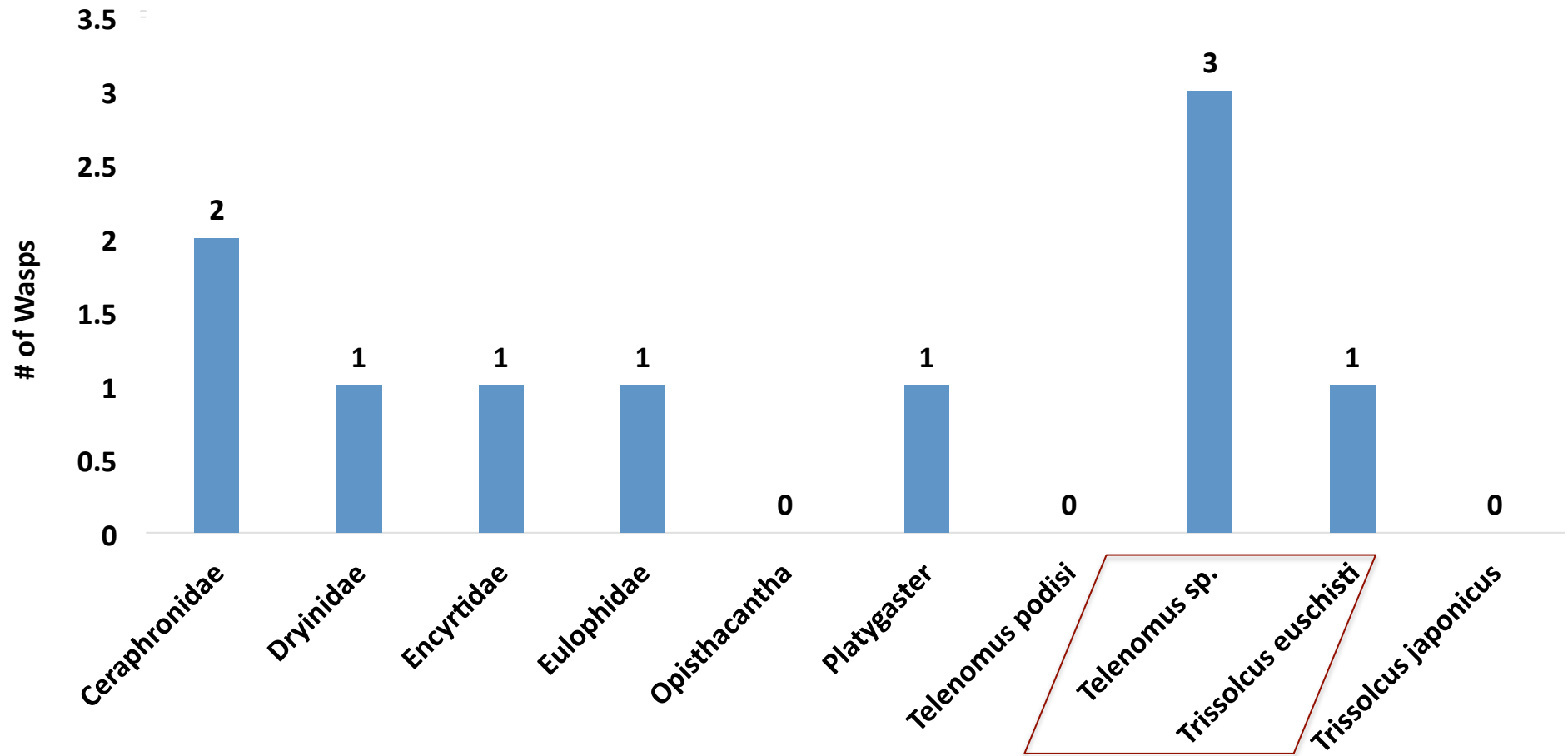
Parasitoid Survey – Western NY Using Alpha Scent Cards

KM Davies Site 1 Williamson NY
7/3 - 10/3 2018



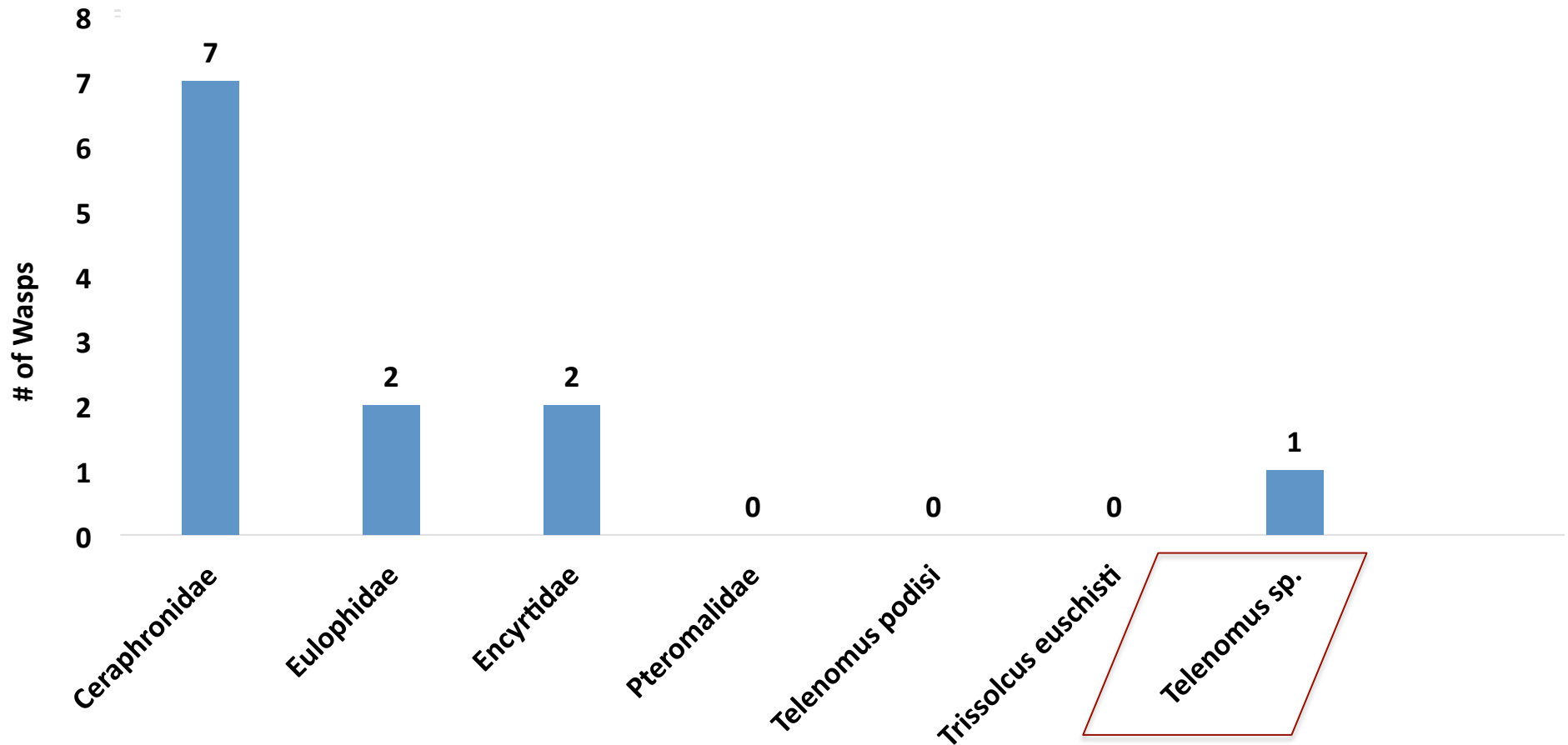
Parasitoid Survey – Western NY Using Alpha Scent Cards

KM Davies Site 2 Williamson NY
7/3 - 10/3 2018



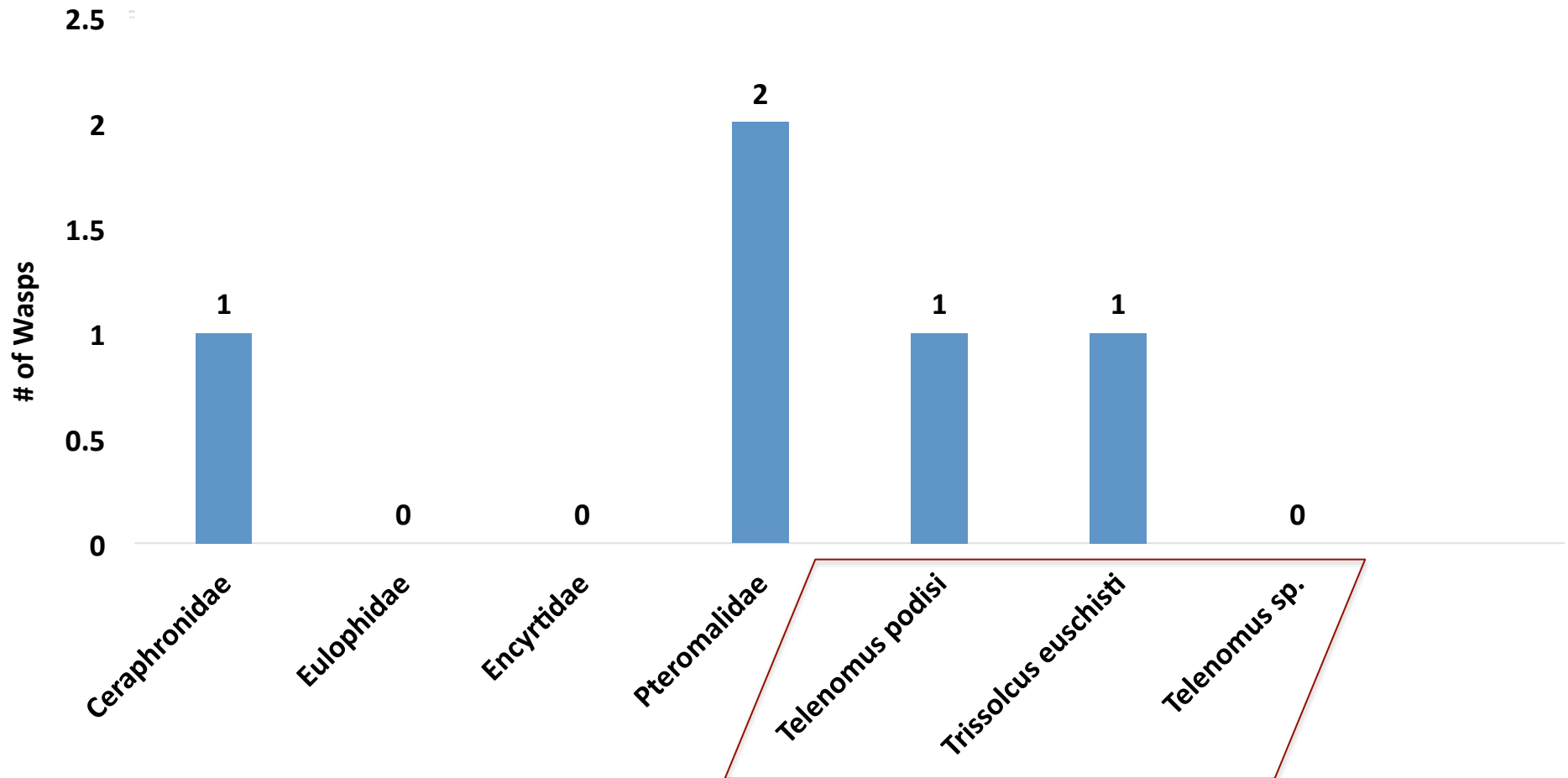
Parasitoid Survey – Western NY Using Alpha Scent Cards

Schutt Site 1 Webster NY
7/3 - 9/9 2018



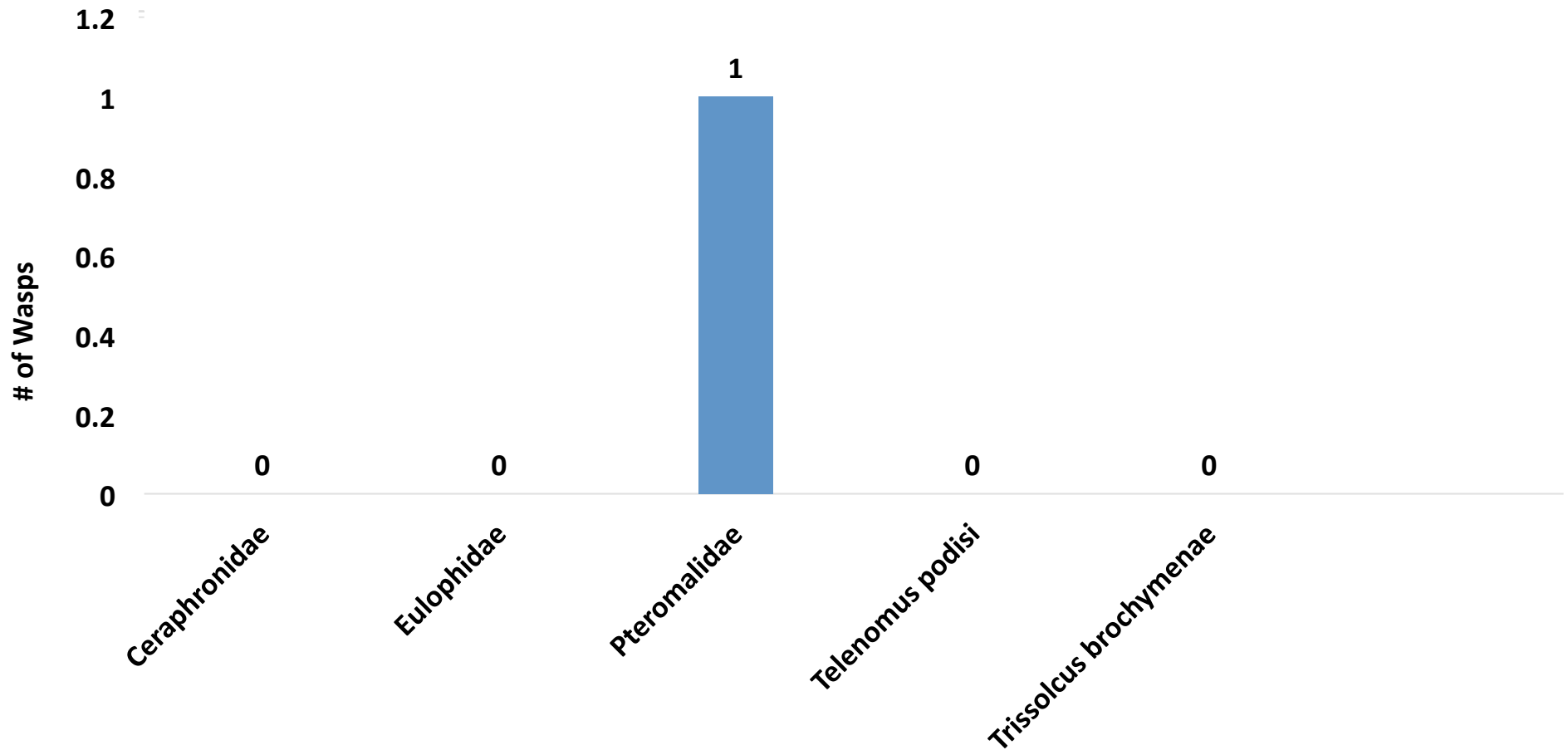
Parasitoid Survey – Western NY Using Alpha Scent Cards

Schutt Site 2 Webster NY
7/3 - 9/9 2018



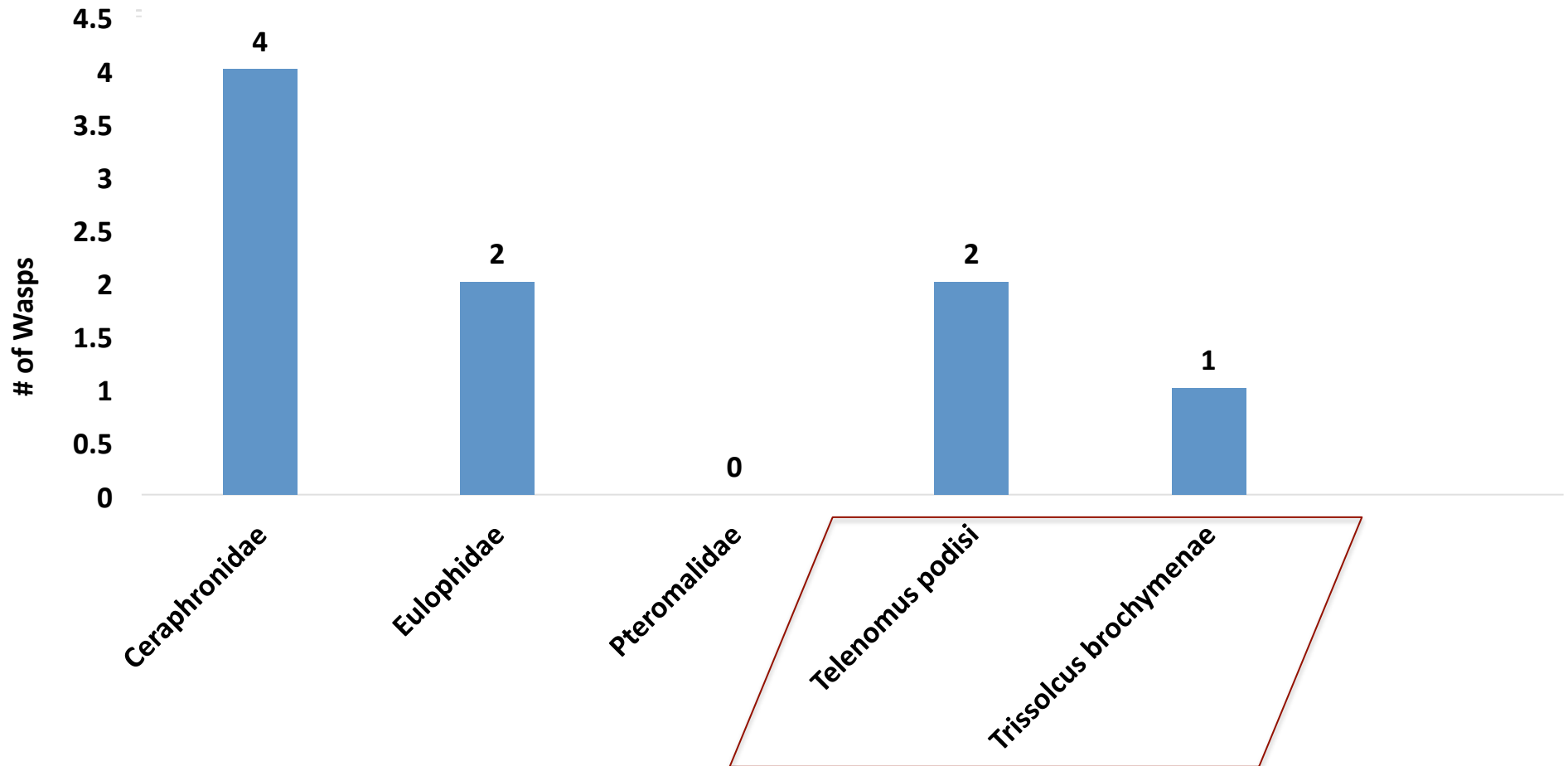
Parasitoid Survey – Western NY Using Alpha Scent Cards

Pankratz Site 1 North Rose NY
7/3 - 10/3 2018



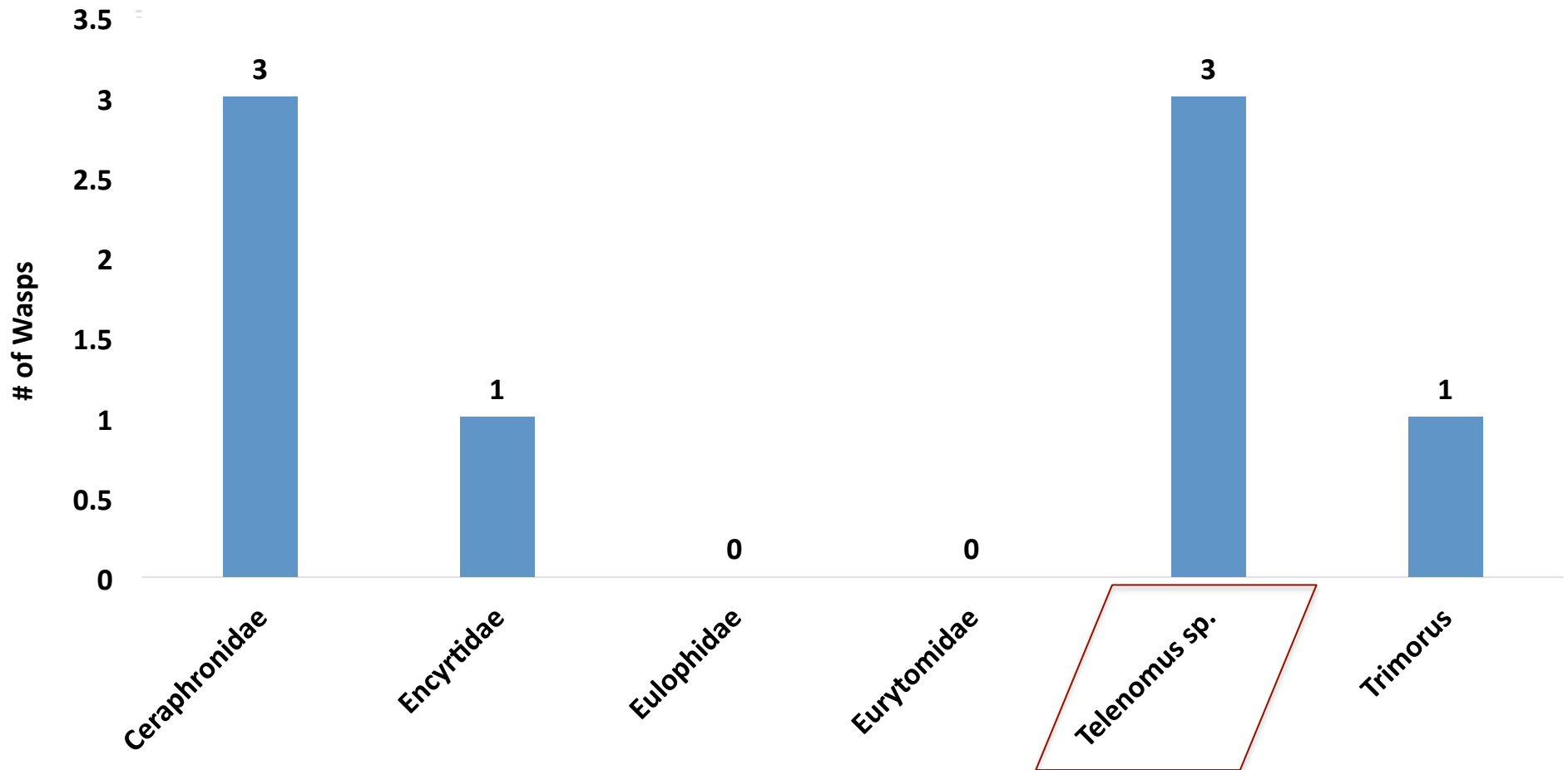
Parasitoid Survey – Western NY Using Alpha Scent Cards

Pankratz Site 2 North Rose NY
7/3 - 10/3 2018



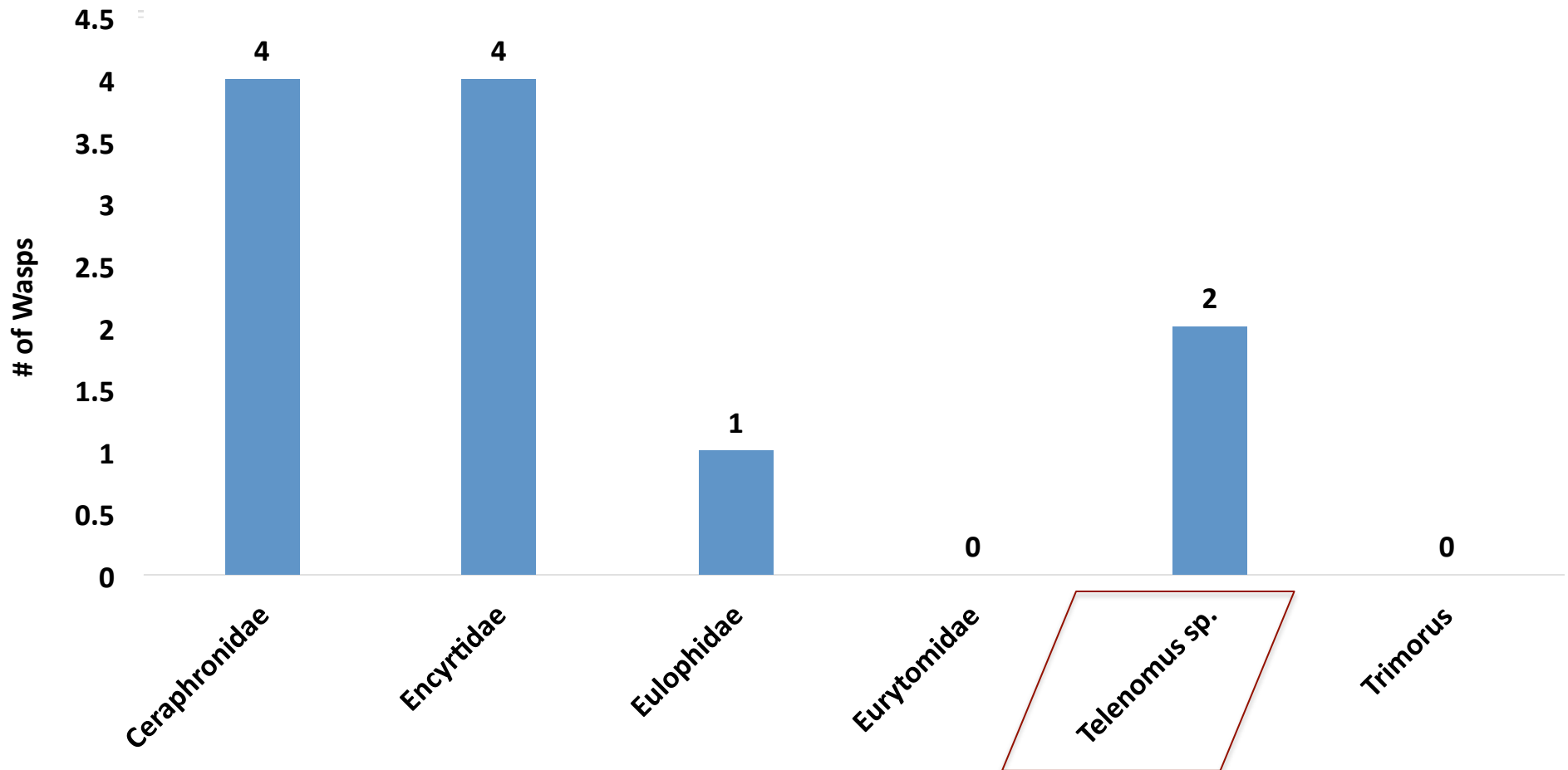
Parasitoid Survey – Western NY Using Alpha Scent Cards

Holley NY Site 1
7/19 - 9/27 2018



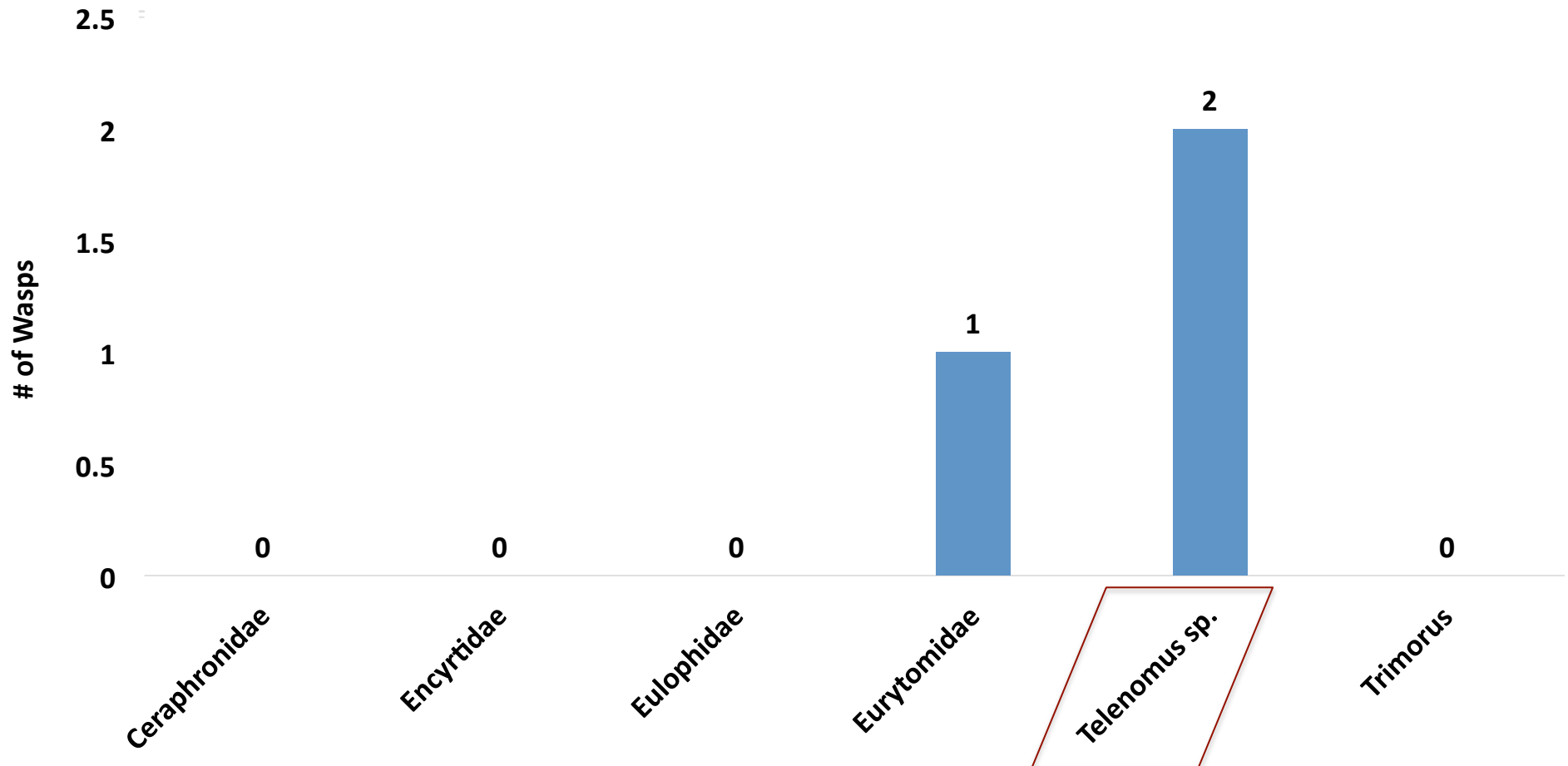
Parasitoid Survey – Western NY Using Alpha Scent Cards

Holley NY Site 2
7/19 - 9/27 2018



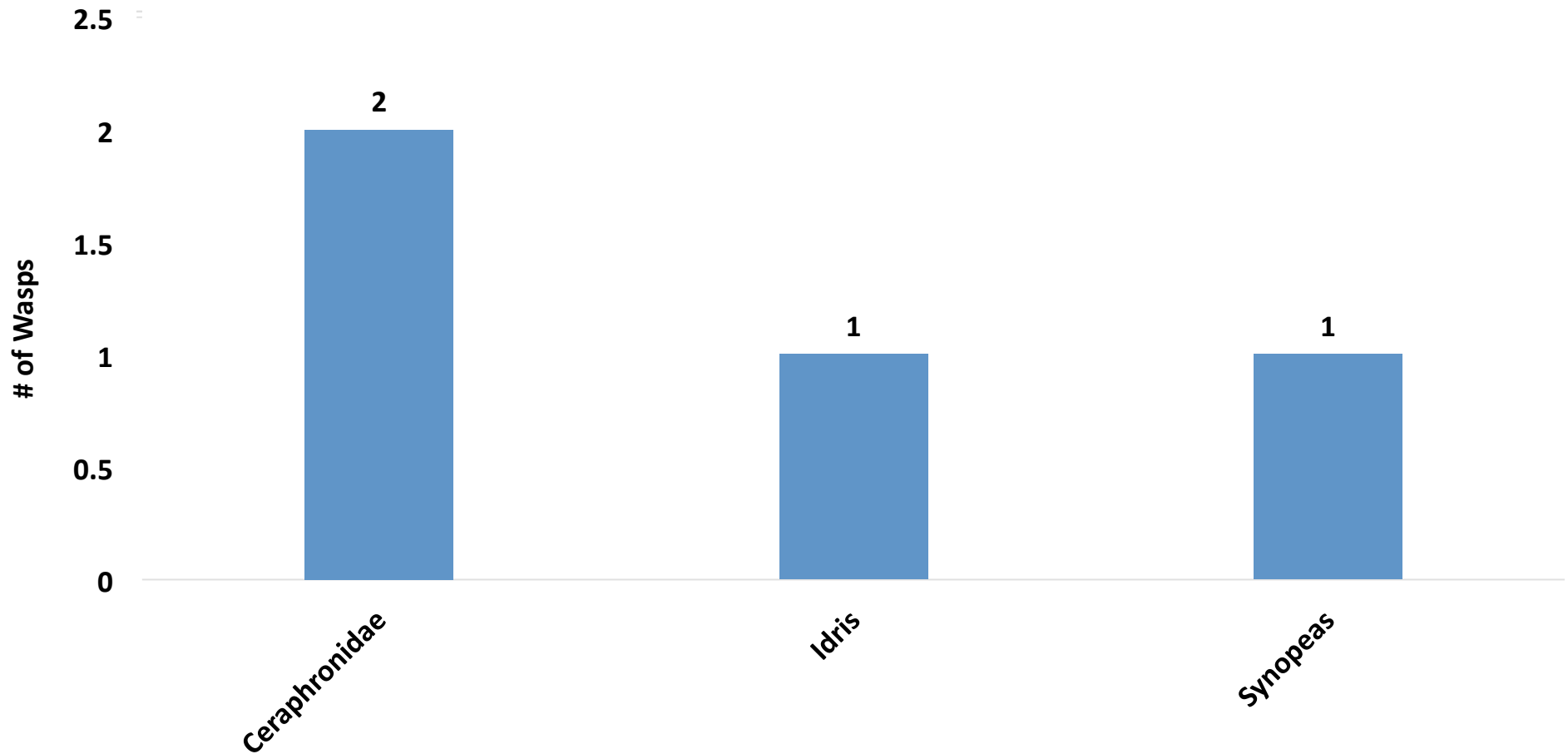
Parasitoid Survey – Western NY Using Alpha Scent Cards

Holley NY Site 3
7/19 - 9/27 2018



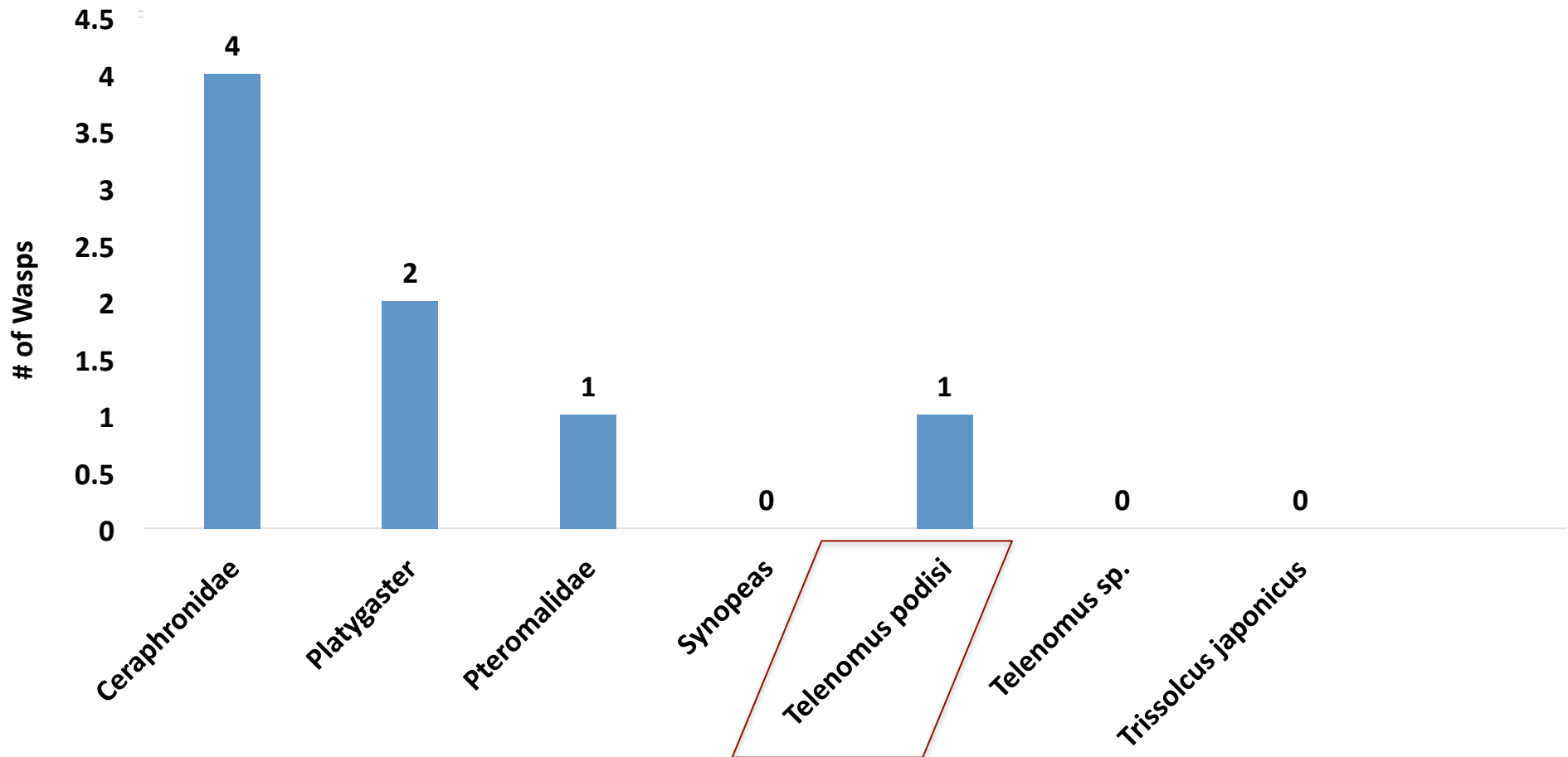
Parasitoid Survey – Eastern NY Using Alpha Scent Cards

Hudson Valley Research Lab Highland NY
8/20/18



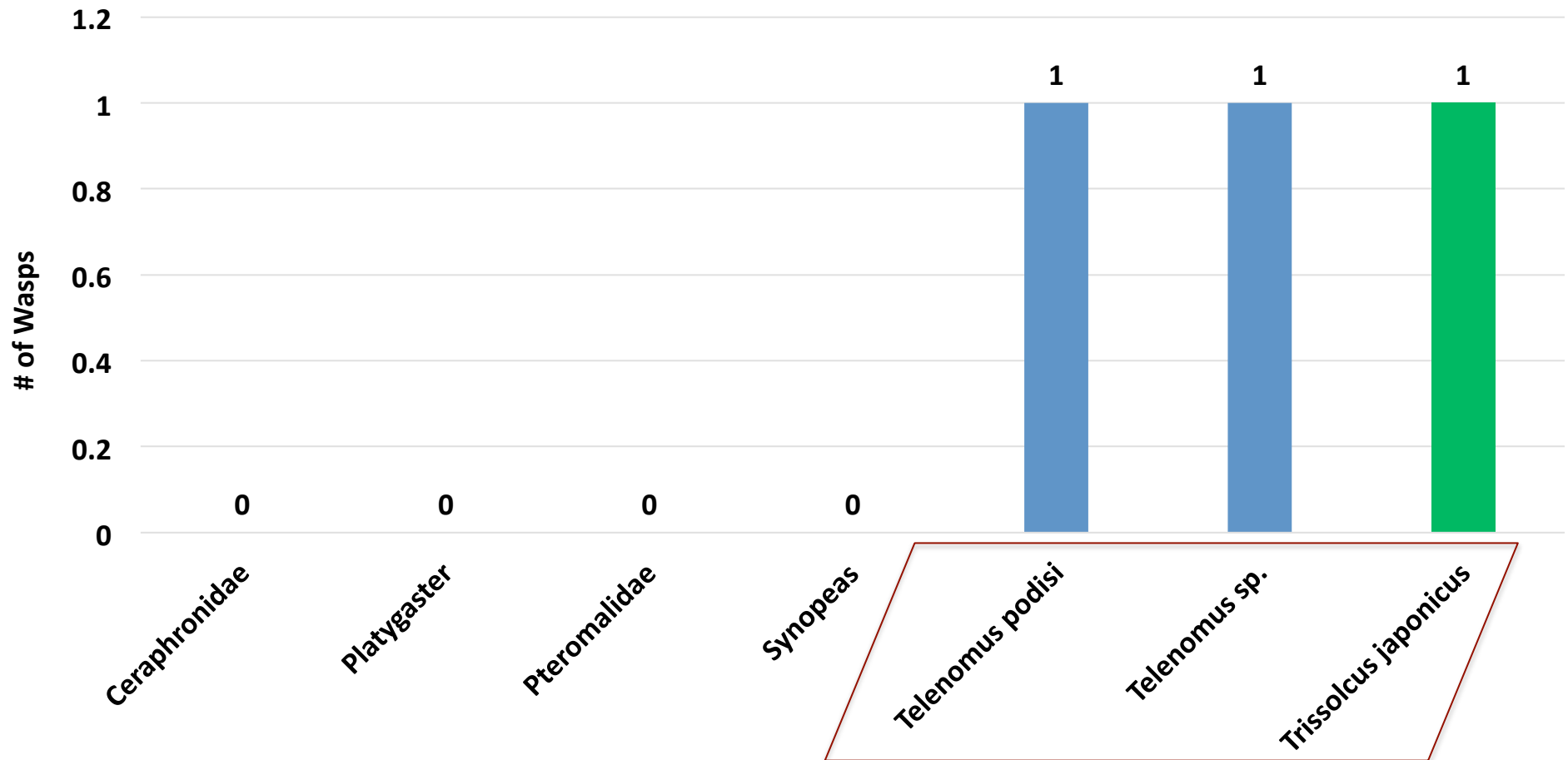
Parasitoid Survey – Eastern NY Using Alpha Scent Cards

Minard Thruway Ground New Paltz NY
5/7 - 10/18 2018



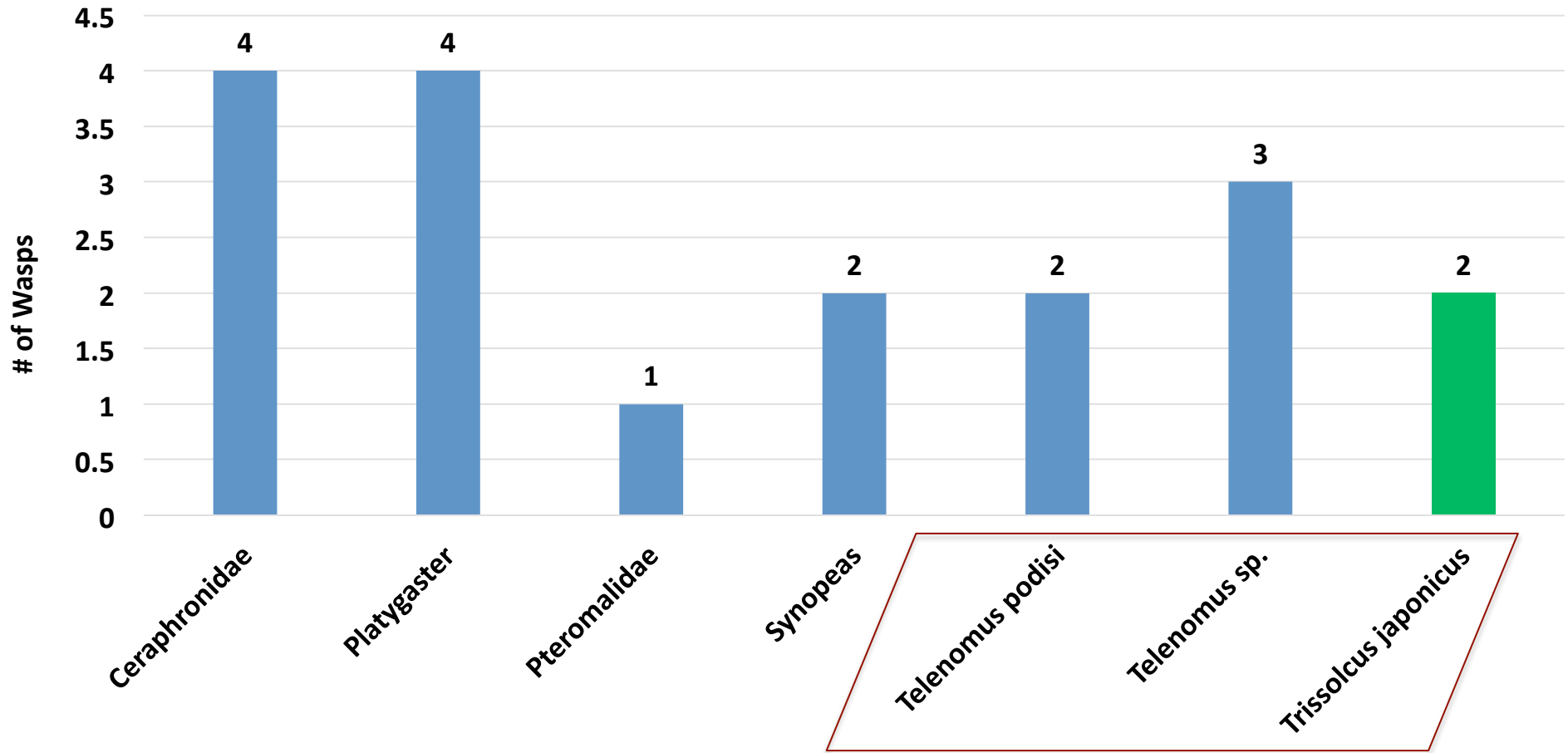
Parasitoid Survey – Eastern NY Using Alpha Scent Cards

Minard Thruway Low New Paltz NY
5/7 - 10/18 2018



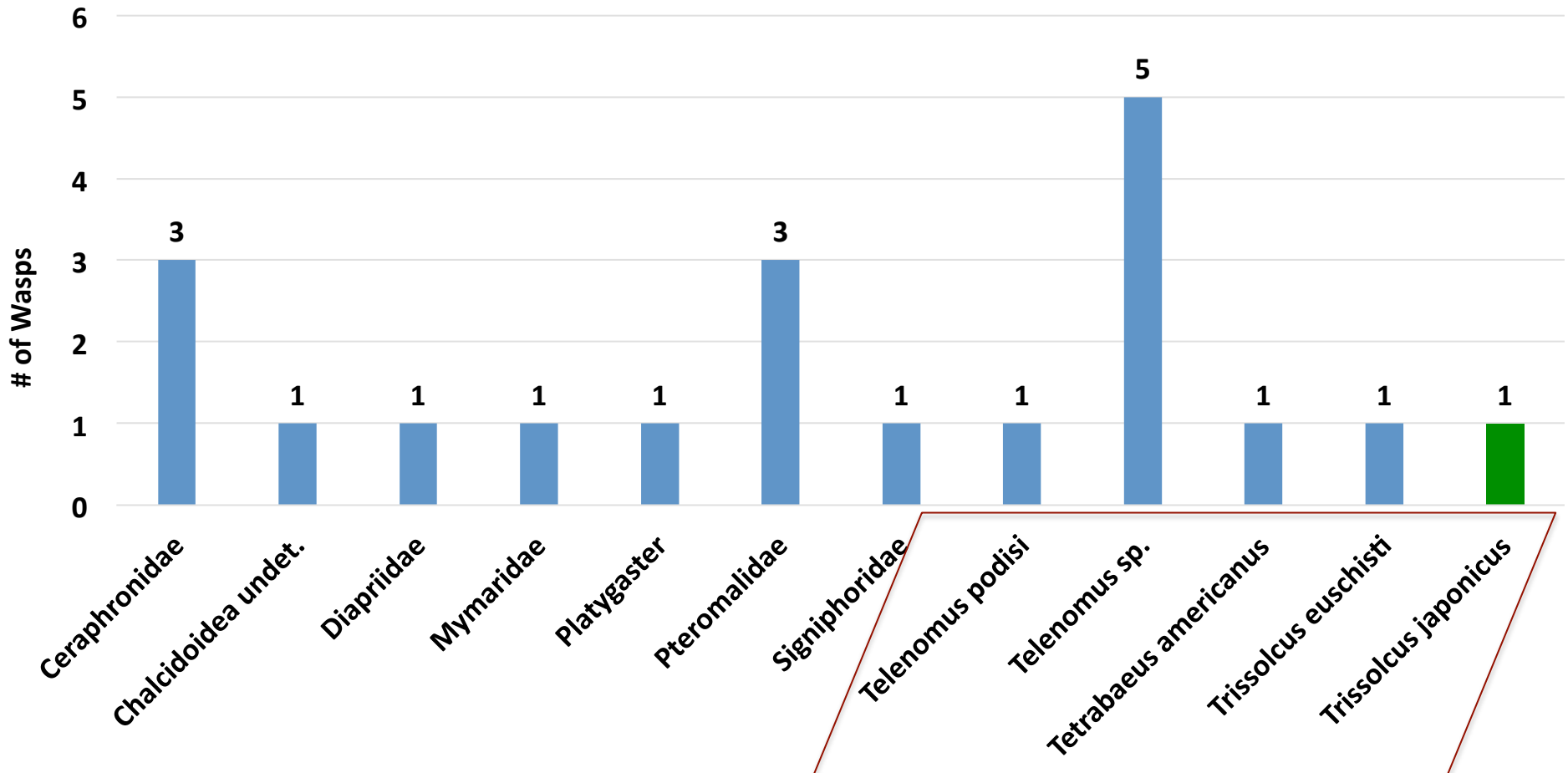
Parasitoid Survey – Eastern NY Using Alpha Scent Cards

Minard Thruway High New Paltz NY
5/7 - 10/18 2018



Parasitoid Survey – Eastern NY Using Alpha Scent Cards

Poughkeepsie Farm Project
7/6 - 8/27 2019



2018 Redistribution Sites

Additional Redistribution Sites

- 2 Low (24 adults) and 2 High (108 adults) release sites in 3 Counties, Ontario, Dutchess and Orange
- 1 site with no T.j. emergence from parasitized egg cluster in Orange County initial 2017 redistribution site

Monitored BMSB and Fruit Injury in *T. japonius* release sites

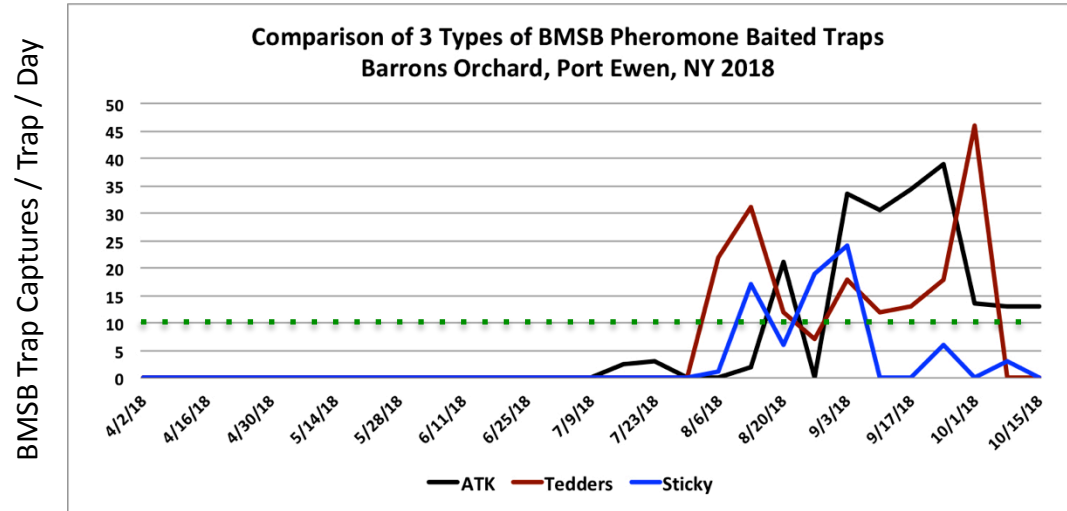
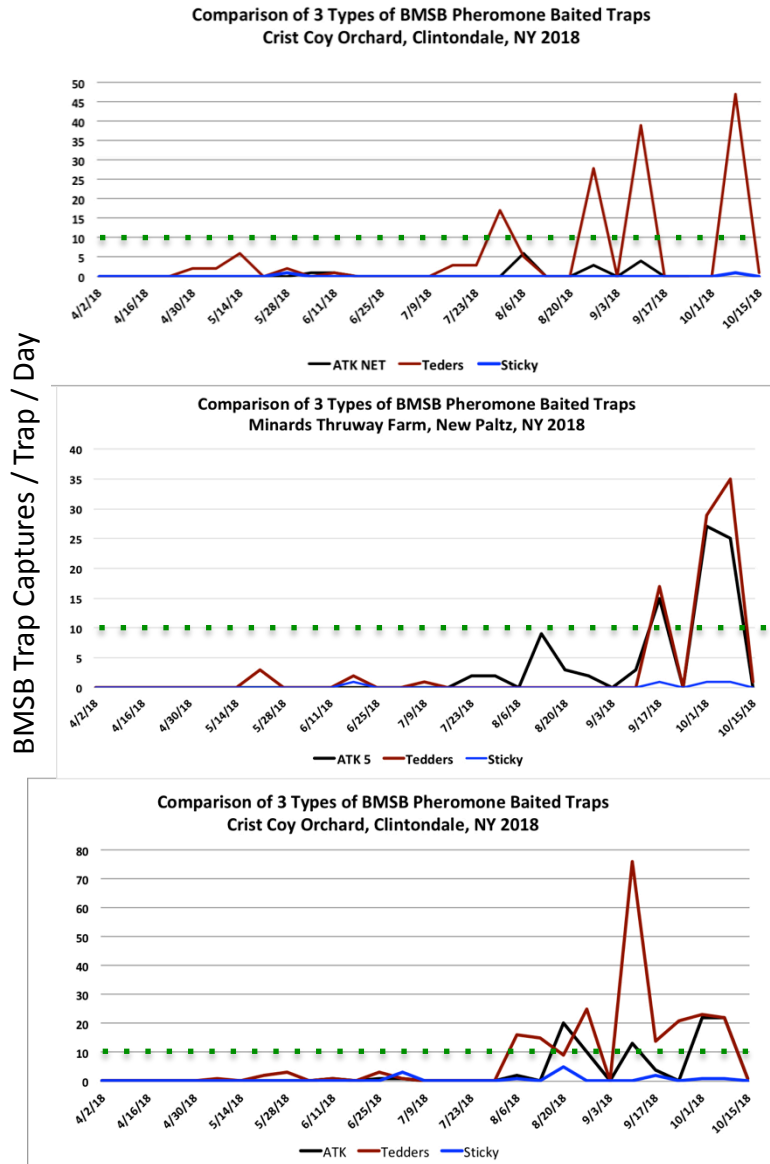
- Release and non-release sites
- Use of standard BMSB Tedders traps, pheromone and Vestigaard net with and without LED lighting



2018 Monitoring: Stink Bug Complex

'17 *Trissolcus japonicus* release sites

Non-T. japonicus release site



In NYS BMSB Monitoring Traps:

- Tedders traps most effective to assess mid and late season BMSB population above thresholds.



Future Studies: Orchard Conservation Strategies For Samurai Wasp

1. Attract and Kill

- Pheromone and Insecticide impregnated netting
- Use of LED rechargeable lighting to increase BMSB captures

2. Exclusion

- Drape netting for stink bug exclusion

3. Spray Technology to Reduce Drift

- Using tower sprayer
- Smaller droplet size, lower volume, increased speed
- Optimize coverage to canopy



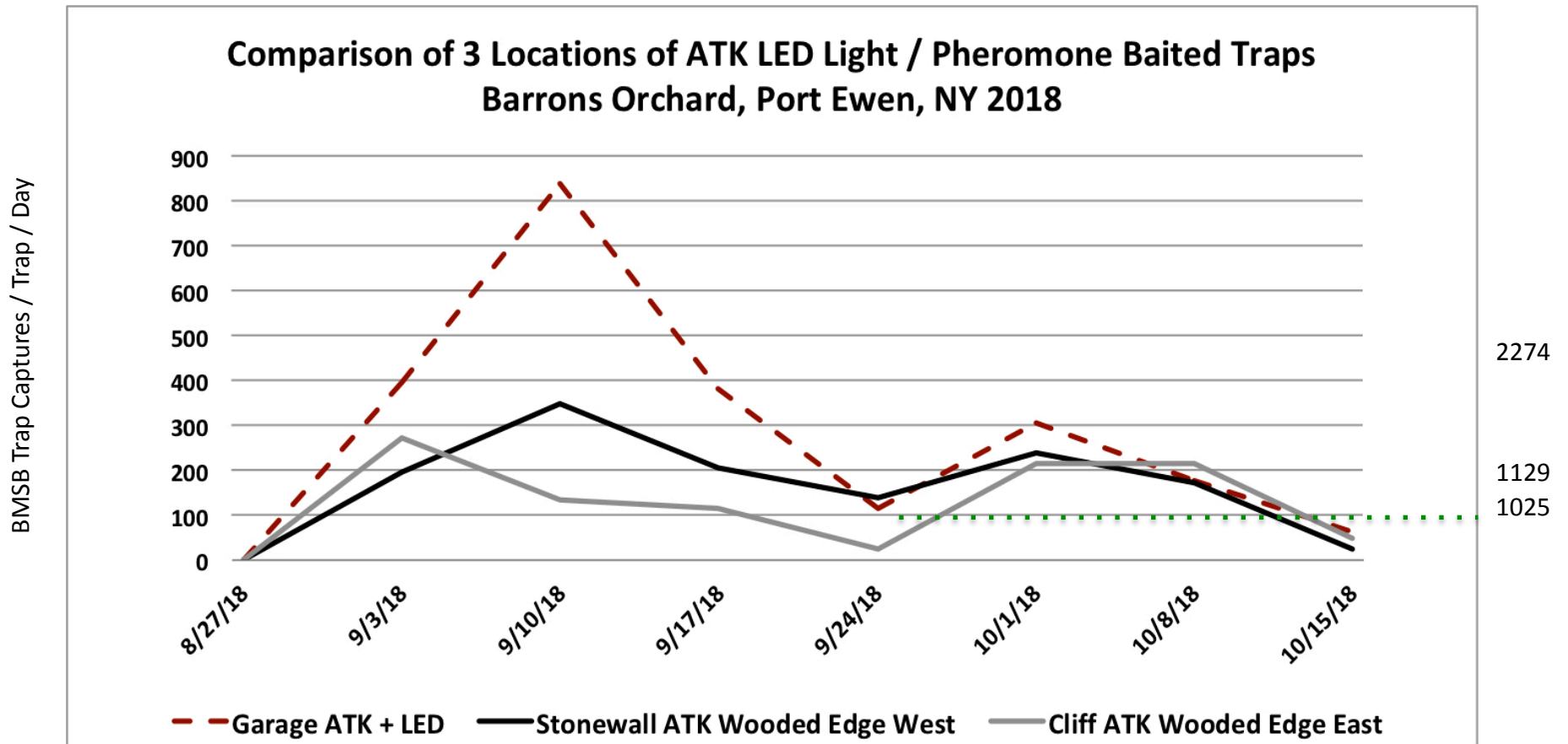
Monitoring *the* Stink Bug Complex Using Free Standing Solar LED ATK + Phermone



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Hudson Valley Research Laboratory

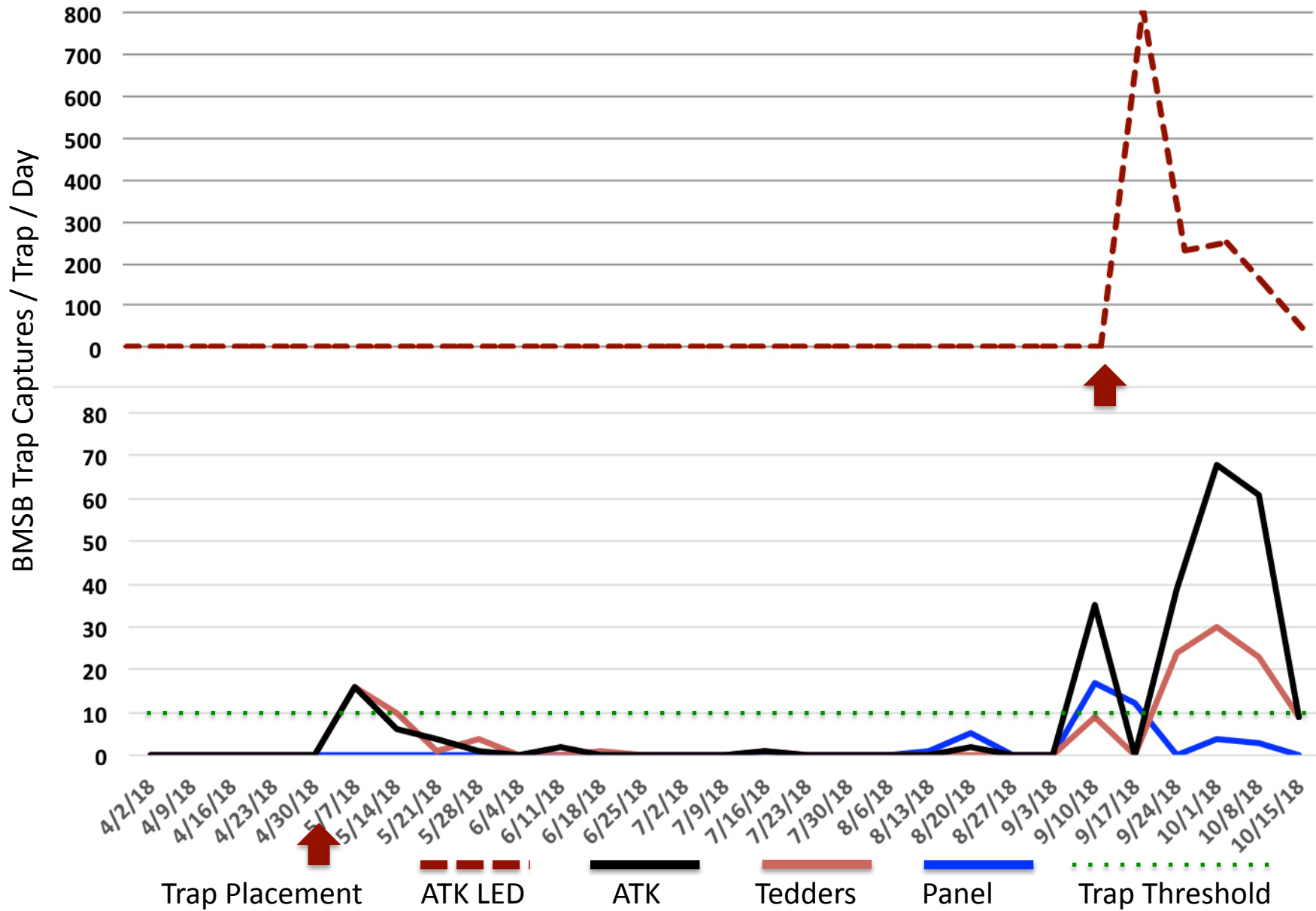
Attract & Kill of the Stink Bug Complex To Reduce BMSB Populations Along the Orchard Edge



Including Solar LED auto-on with ATK / pher. increases BMSB captures



Comparison of 4 BMSB Pheromone Baited Traps Hepworth's Organic Vegetable, Marlboro, NY 2018



Drape Net Insect Exclusion Study Samurai Wasp Conservation



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Drape Net Insect Exclusion Study Stink Bug Exclusion ?



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Drape Net Insect Exclusion Study Samurai Wasp Conservation

Treatment/Formulation	RateTiming	Application Dates	
Early Season IPM			
Actara	5.5 oz/A	18 th May	Pre-Net
Avaunt	6.0 oz/A	25 th May	↓
Entrust SC	10.0 fl oz/A	8 th June	Post-Net Application
Venerate	2.0 gal/A	21 st June	↓
Season Long IPM			
Actara	5.5 oz./A	18 th May	Pre-Net
Avaunt	6.0 oz./A	25 th May	↓
Imidan 70W	4.9 lbs/A	7 th June	Post-Net Application
Esteem 35WP	5.0 oz/A	21 st June	↓
Assail 30SG	4.0 oz/A	21 st June	
Altacor	4.5 oz/A	21 st June	
Assail 30SG	4.0 oz/A	10 th July	
Exirel	20.5 oz/A	24 st July	
Exirel	20.5 oz/A	31 st July	
Exirel	20.5 oz/A	6 th Aug.	
Bifenture 10DF	32.0 oz/A	6 th Aug.	



Drape Net Insect Exclusion Study Samurai Wasp Conservation

Results of 2018 Insecticide and Acaricide Studies in Eastern New York. Jentsch et. al.

Table 1 Management of the Apple Insect Complex Using 'Drape Net' IPM / Organic Split and Season Long IPM Management . Hudson Valley Research Laboratory, Highland, NY - 2018

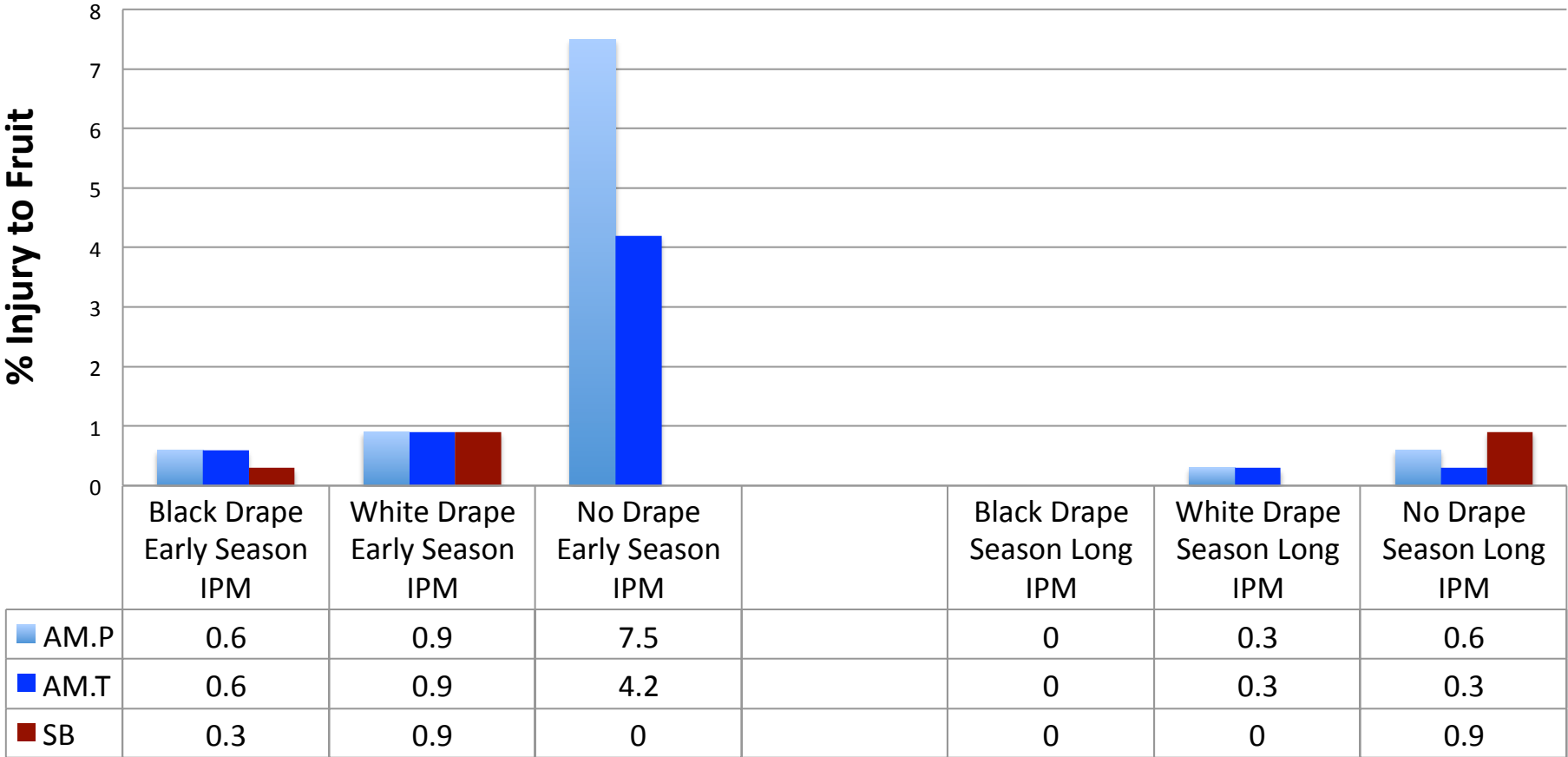
Net Type Treatment / Rate	Incidence (%) of insect damaged cluster fruit											
	PC	EAS	TPB	Lf.Rlr	Int. Lep	Ext.Lep	CM	AM.P	AM.T	SJS	SB	Clean
1. Black Drape Early Season IPM	3.0 a	0.6 a	4.4 a	10.9 bc	2.2 b	18.8 b	11.3b	0.6 b	0.6 b	96.3 a	0.3 b	1.3 c
2. White Drape Early Season IPM	4.7 a	0.0 a	4.4 a	11.9 b	3.1 b	20.3 b	12.5 b	0.9 b	0.9 b	95.6 a	0.9 b	0.6 c
3. No Drape Early Season IPM	10.8 a	0.8 a	4.6 a	22.9 a	6.7 a	37.1 a	23.8 a	7.5 a	4.2a	83.8 b	3.8 a	1.3 c
4. Black Drape Season Long IPM	5.6 a	1.3 a	7.8 a	0.3 d	0.0 c	1.6 c	0.3 c	0.0 bc	0.0 b	6.6 d	0.0 b	82.5 a
5. White Drape Season Long IPM	7.8 a	0.9 a	7.8 a	0.3 d	0.0 c	0.6 c	0.0 c	0.3 bc	0.3 b	20.0 c	0.0 b	65.9 b
6. No Drape Season Long IPM	5.6 a	0.9 a	5.0 a	0.6 cd	0.3 c	1.3 c	0.0 c	0.6 bc	0.3 b	6.3 d	0.9 b	81.3 a
P value	0.2062	0.6565	0.5998	0.0001	0.0001	0.0001	0.0001	0.0001	0.0135	0.0001	0.0154	0.0001

^a Evaluation made on 'Crimson Crisp, Honey Crisp & Gold Rush cultivars harvested on 29 September. Data were transformed using arcsine(sqrt(x)) prior to ANOVA (P ≤0.05). Means separation by Fisher Protected (P ≤0.05); treatment means followed by the same letter are not significantly different. Arithmetic means reported.



Drape Net Insect Exclusion Study Samurai Wasp Conservation

IPM / Organic Split and Season Long IPM in Apple Management Programs Using 'Drape Net' .



Conclusion – 2019

T.japonicus has been re-distributed to 40 NYS farm sites

- 2019: **Increase T.j. release sites** in NY by 50-100%
- **Monitor representative release sites** to determine efficacy
 - BMSB presence using trapping; BMSB injury to crops
 - Monitor Samurai wasp: sentinel egg and yellow cards
- Developing **attract and kill strategies** along orchard perimeter to conserve *T.japonicus*
- Demo **spray drift field workshops to reduce drift** into woodland habitat.





Thanks to the staff at the HVRL for all their support:

- | | |
|---|--|
| Research Support Specialist I | Dana Acimovic |
| <i>Laboratory Technician</i> | Lydia Brown |
| <i>Research Assistant</i> | Christopher Leffelman |
| <i>Research Assistant</i> | Lucas Canino |
| <i>Farm Manager</i> | Albert Woelfersheim |
| <i>Administrative Assistant</i> | Erica Kane |
| <i>Administrative Assistant</i> | Christine Kane |
| <i>HRVL & NEWA Weather Data</i> | Christopher Leffelman, Albert Woelfersheim |

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