BMSB Workgroup, Rutgers, NJ – June 16th, 2016

BMSB CLASSICAL BIOLOGICAL CONTROL: STATUS REPORT

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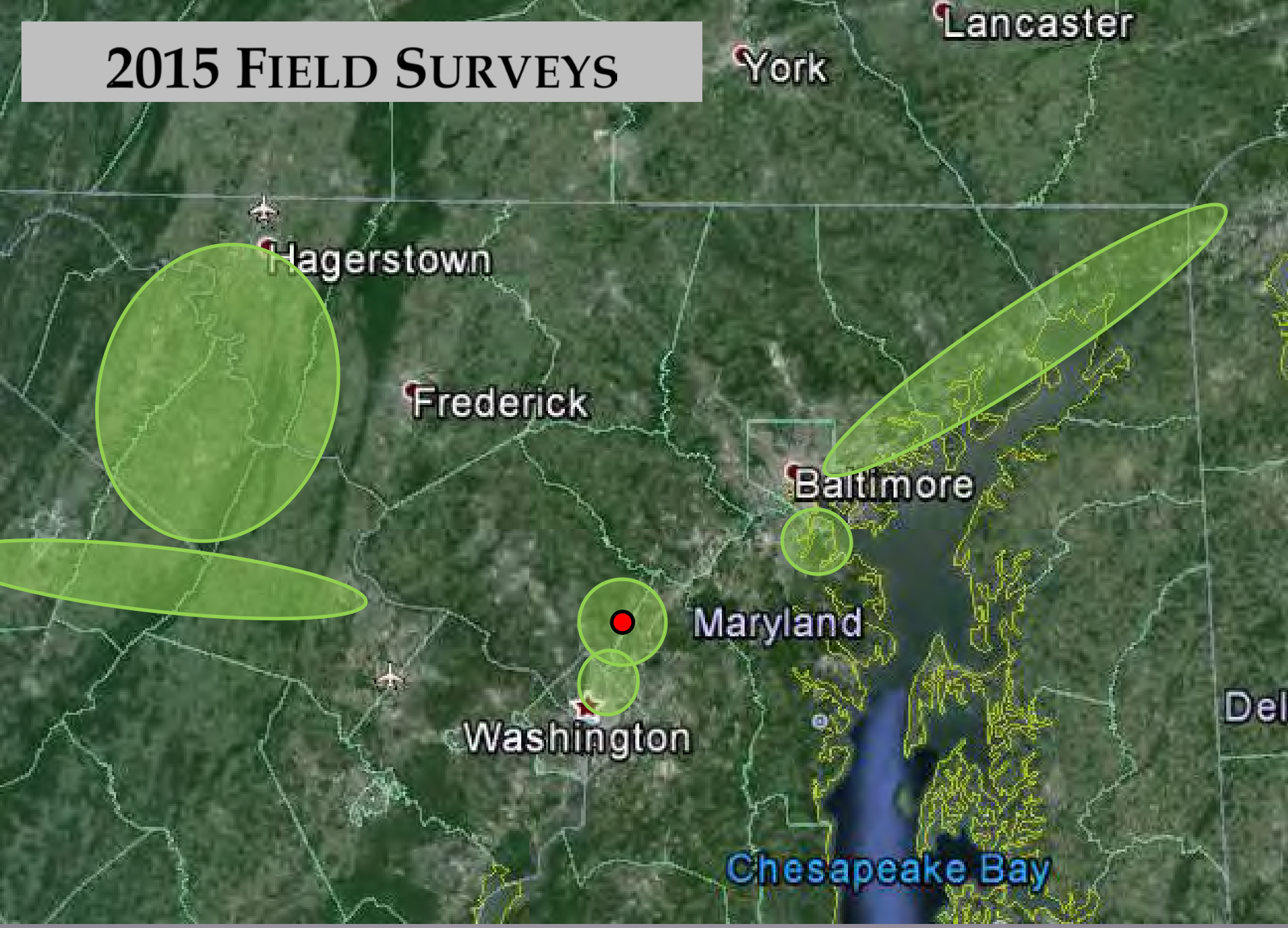
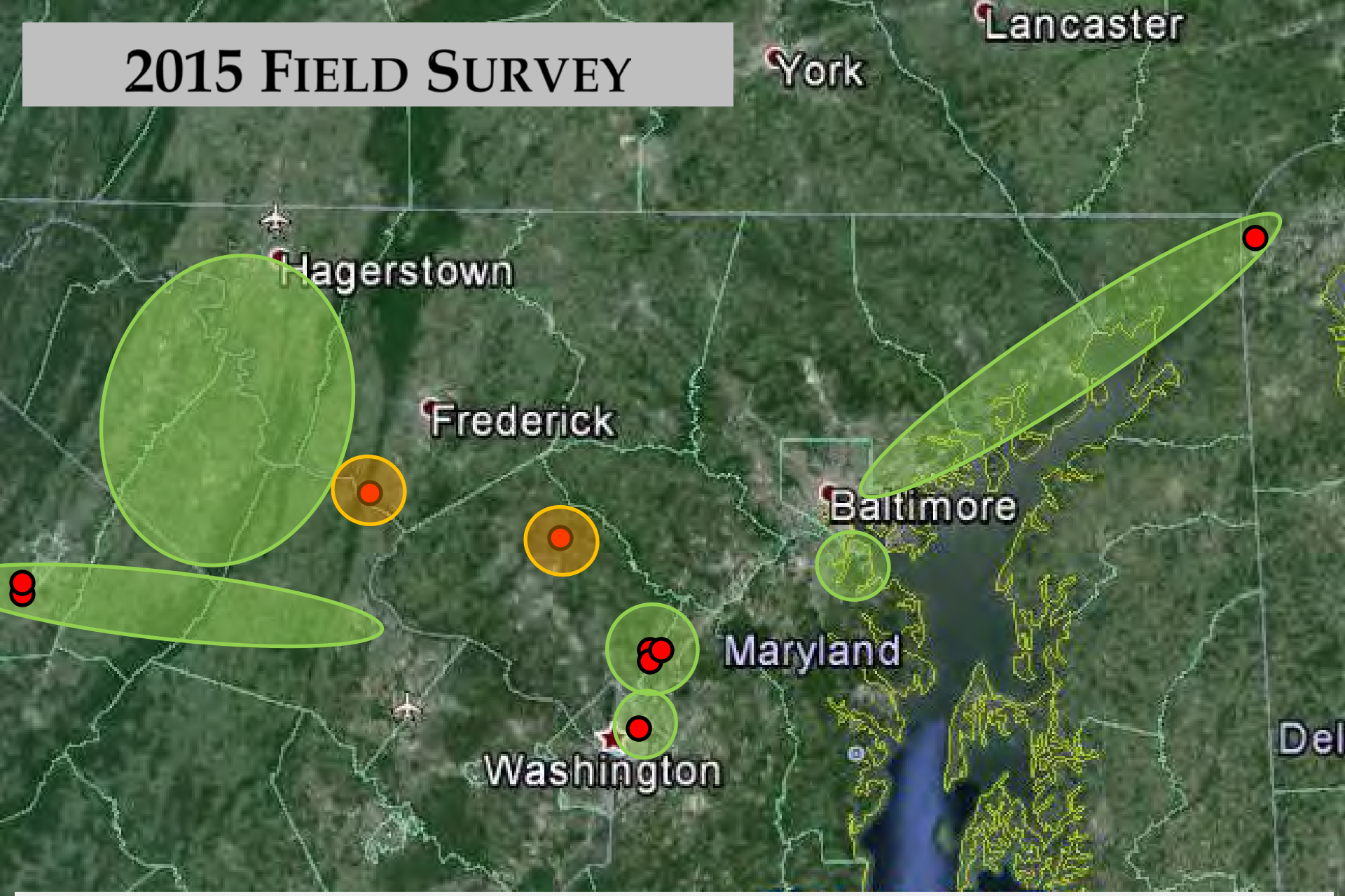
Status of adventive *Trissolcus japonicus* in the U.S. - 2015

Photo: E. Talamas
ARS/SEL

2015 Field Surveys



2015 Field Survey

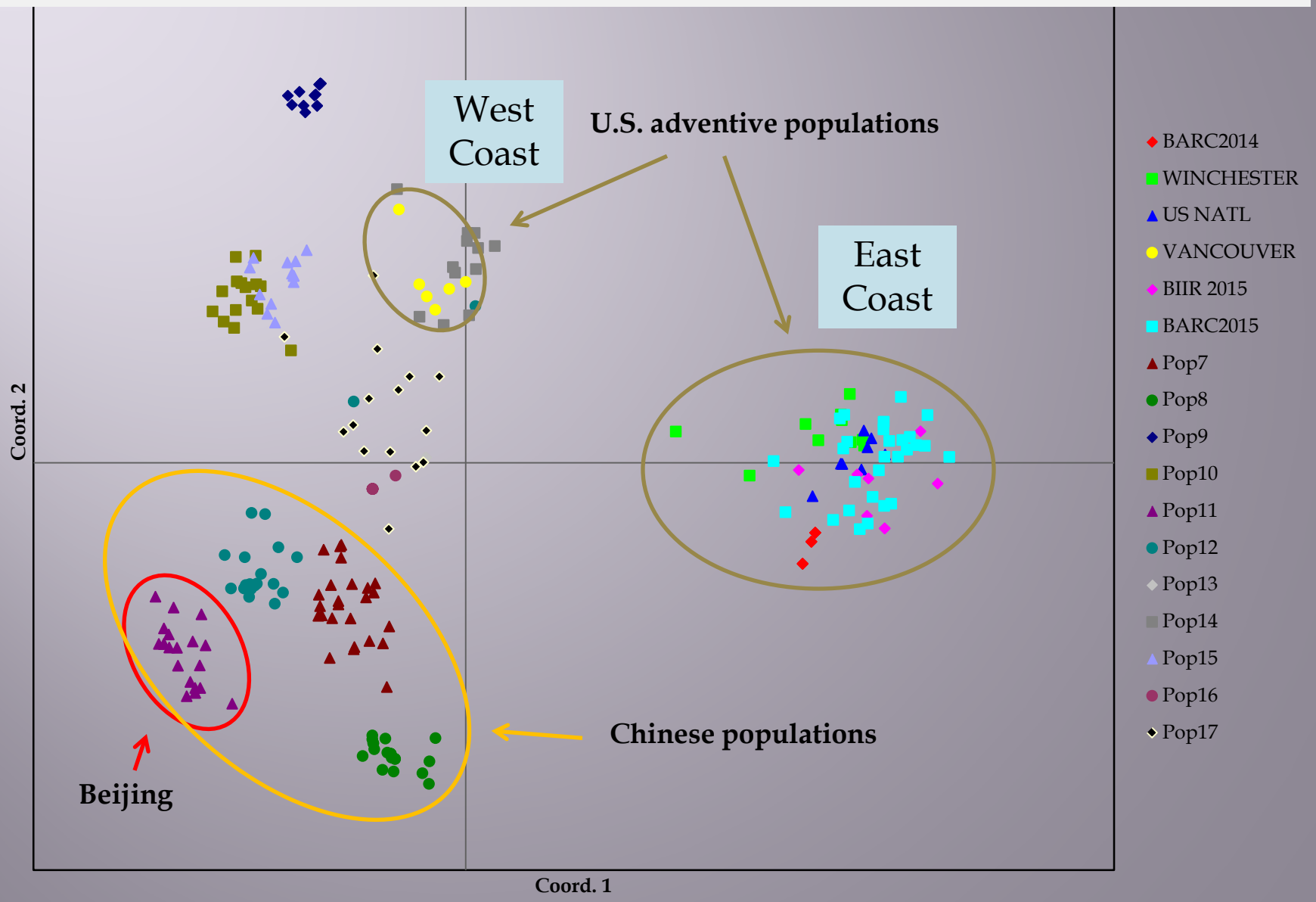


T. japonicus now found in: MD, D.C., VA, DE (east coast) and WA (west coast)

Recoveries were made from BMSB (sentinel & wild), *Podisus* and *Thyanta*


Washington
Hood River
Tualatin
Aurora
Oregon
Corvallis

Principal coordinate analysis (PCoA) of genetic diversity among 23 microsatellite markers in *T. japonicus*



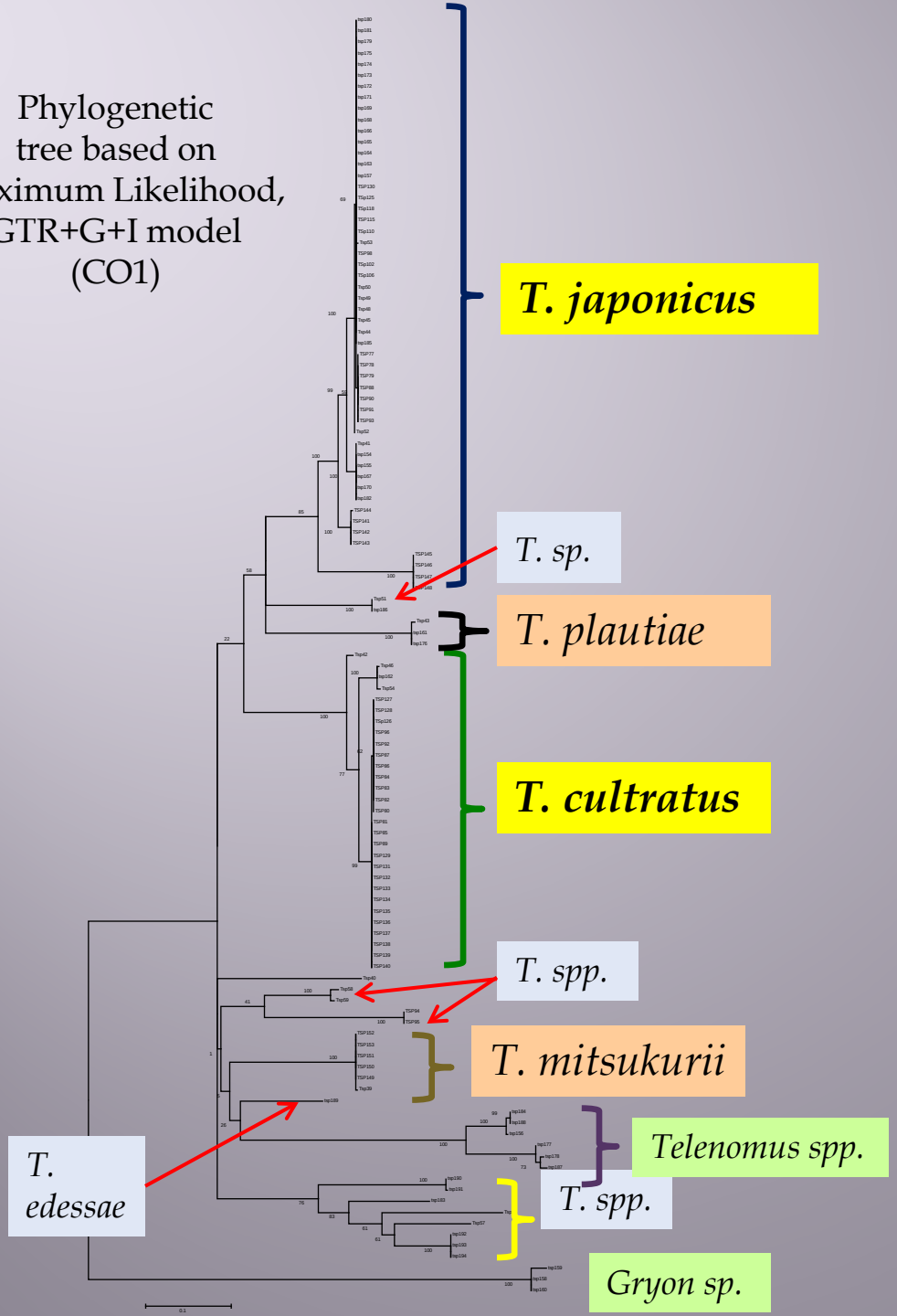
Implications of adventive populations

- Wider regional surveys needed to monitor their spread
- Determine their impact on BMSB & non-targets in the field
- Continue work on a Petition to release **Beijing** *T. japonicus*
- APHIS requires a Petition for each state
- Field recovery/impact data may help to fast-track a Petition to Release in other regions (if it is still needed) or redistribute the adventive populations

Status of Biological Control In North America:

- **Regional surveys (ongoing) to document the occurrence & impact of natural enemies:**
  - Overall low levels of parasitism
  - Impact varies according to habitat
  - Predation is often more important than parasitism
- **Studies in conservation biological control to increase impact of native predators and parasitoids**
  - Border plantings, trap crops, insectary plants
- **Will native natural enemies adapt to BMSB over time?**
  - Why are native parasitoids poorly adapted to BMSB?
  - Can adaptation be enhanced via laboratory selection?

Phylogenetic tree based on Maximum Likelihood, GTR+G+I model (CO1)



Scelionidae from eggs of Asian Pentatomidae

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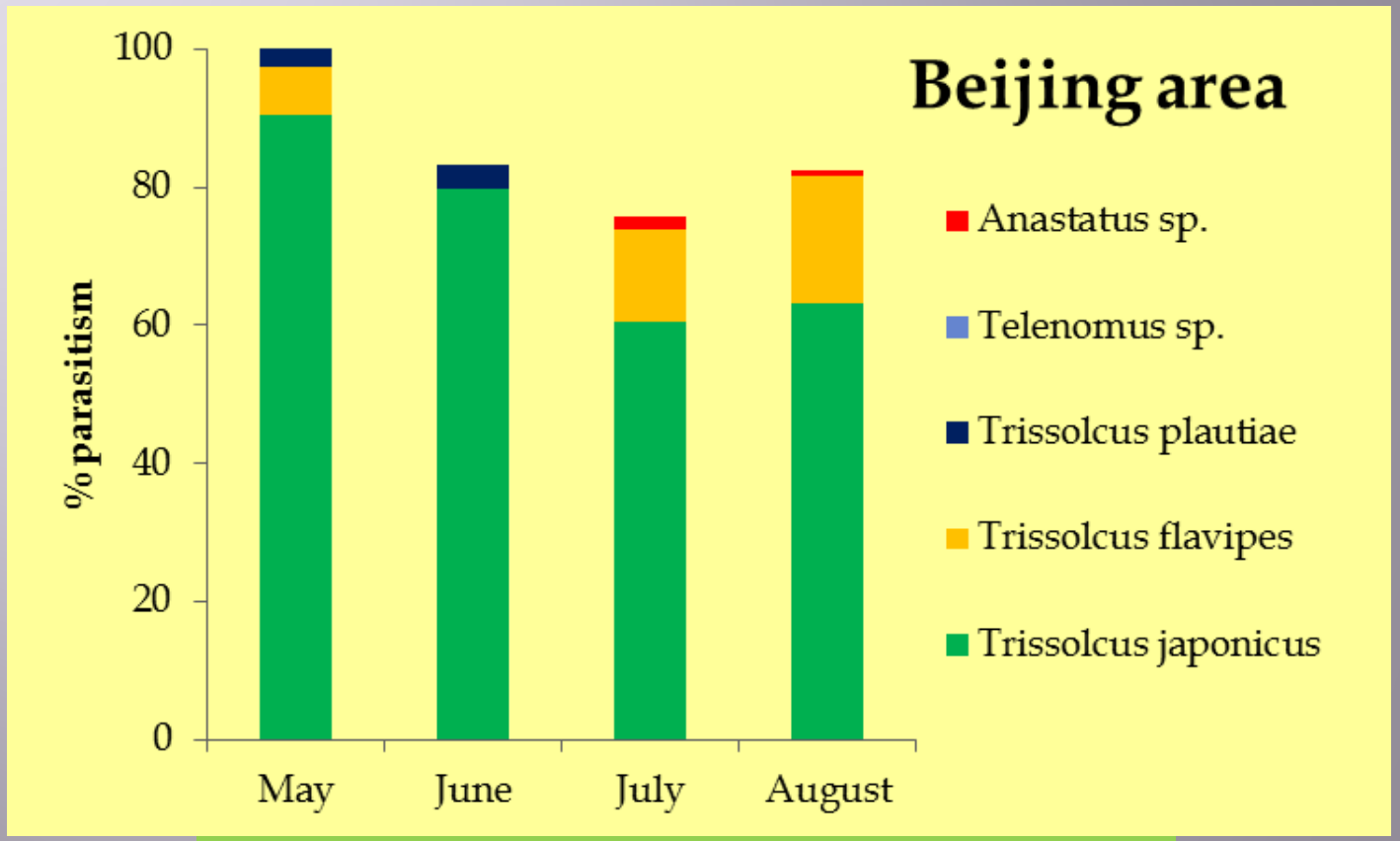
E. Talamas – ARS/SEL
M. Buffington – ARS/SEL
C. Dieckhoff – ARS/BIIR
K. Hoelmer – ARS/BIIR



Data from Tim Haye, CABI Bioscience

Continued field research to determine natural ecological host range of *T. japonicus* in Asia

Trissolcus japonicus is oligophagous
- it attacks several (but not all) Asian pentatomid species

Halyomorpha halys

Glaucias subpunctatus

Plautia crossota

Dolycoris baccarum

Erthesino fullo

Summary – In Asia:

- *T. japonicus* is the dominant species throughout the season on different host plants
- Other species (e.g., *Anastatus, Telenomus*, tachinid flies) are of minor importance in controlling BMSB
- Ecological host range of *T. japonicus* contains other species in these habitats, *e.g. Plautia* and *Dolycoris*
- *T. japonicus* is an oligophagous species, thus non-target attacks likely of some other stink bugs, risk-benefit analysis needed
- Ongoing studies: impact on non-target species, including the predatory species *Arma chinensis*

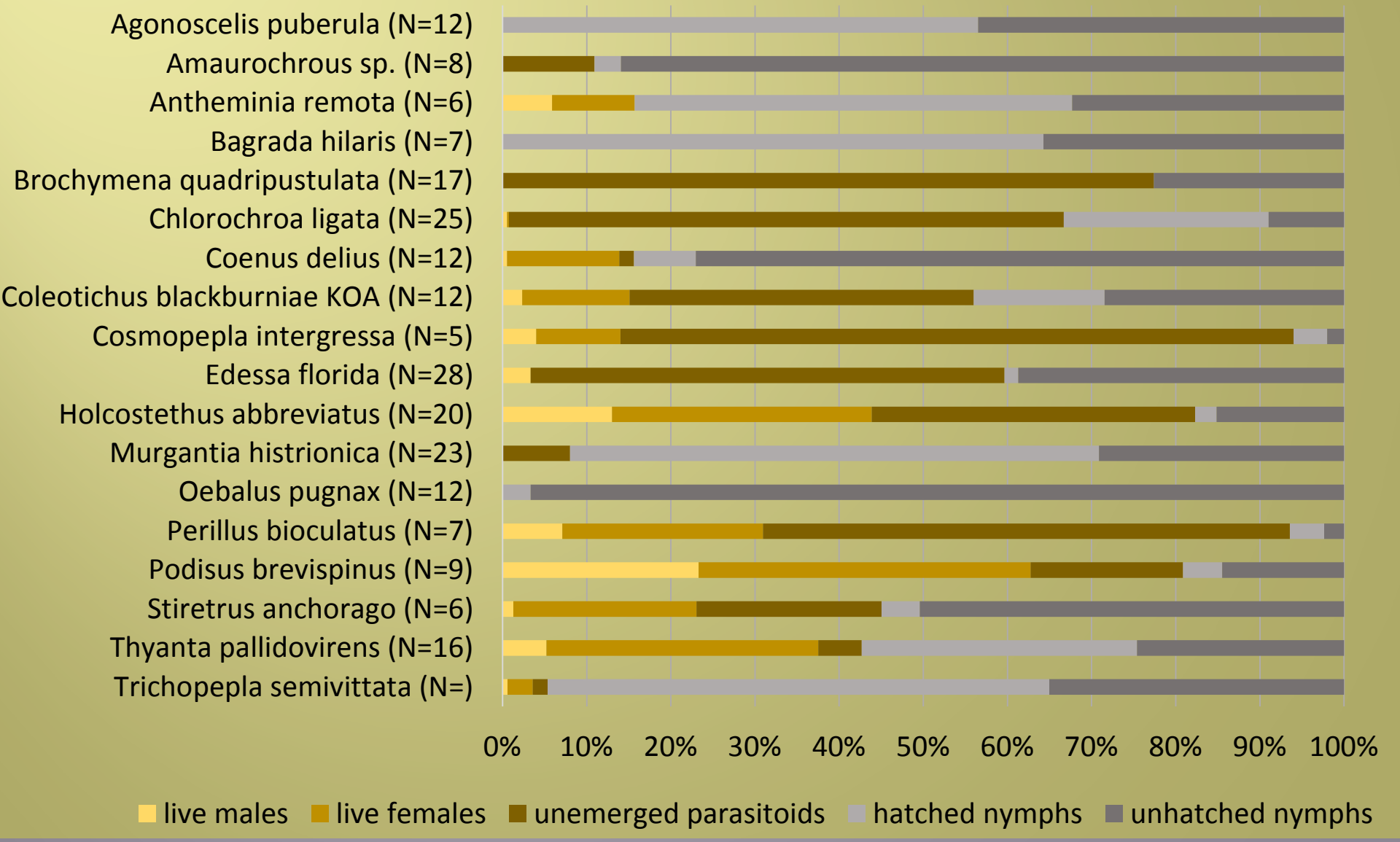
Introducing Asian Parasitoids: Status

NAPPO Guidelines for Petitions for First Release of Arthropod Pest Biological Control Agents

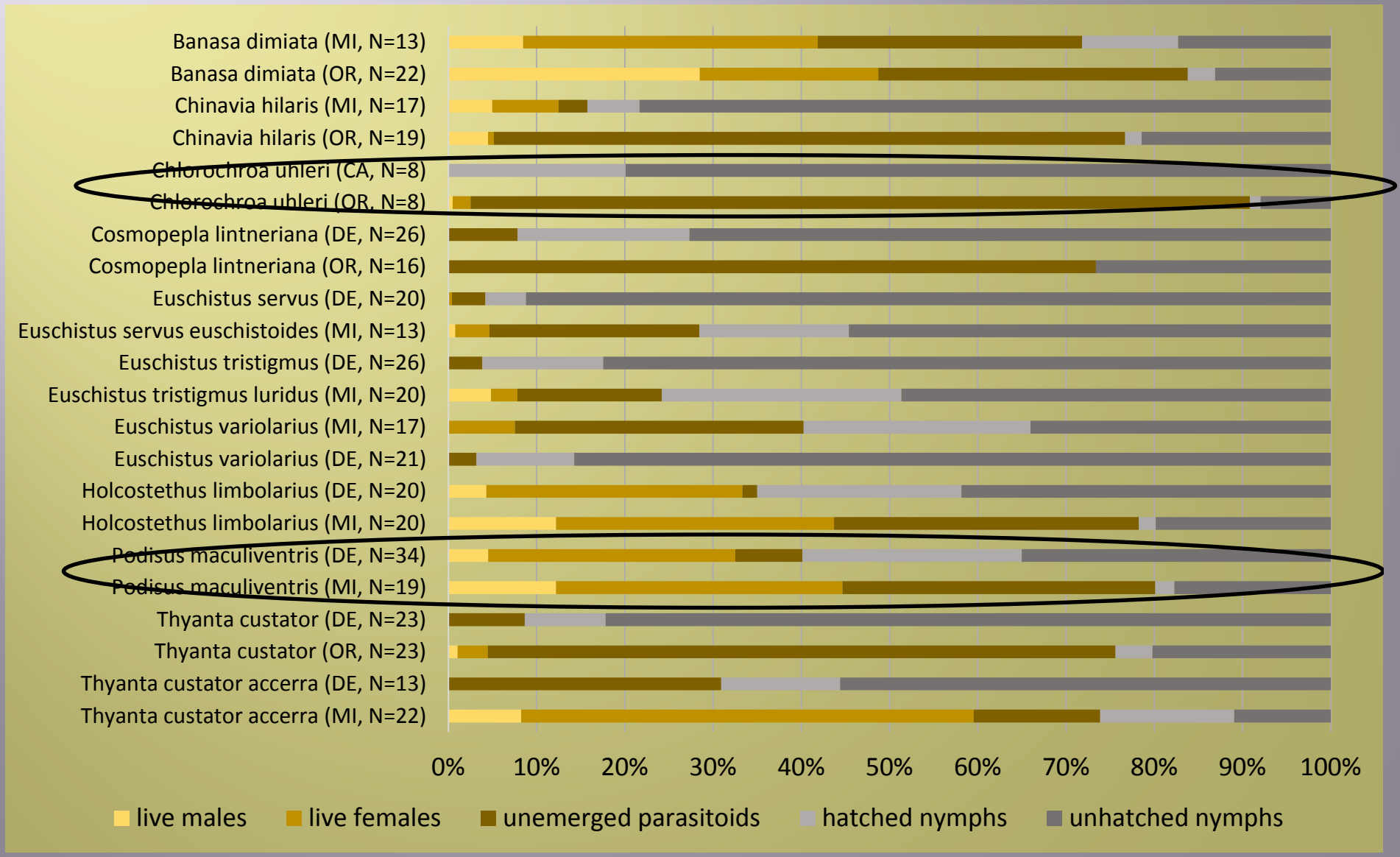
General Requirements

1. Proposed Action
2. Target Pest Information
3. Biological Control Agent Information
4. Host-Specificity Testing
5. Environmental and Economic Impacts of Proposed Release
6. Post-Release Monitoring

No-Choice Test Outcome (1)

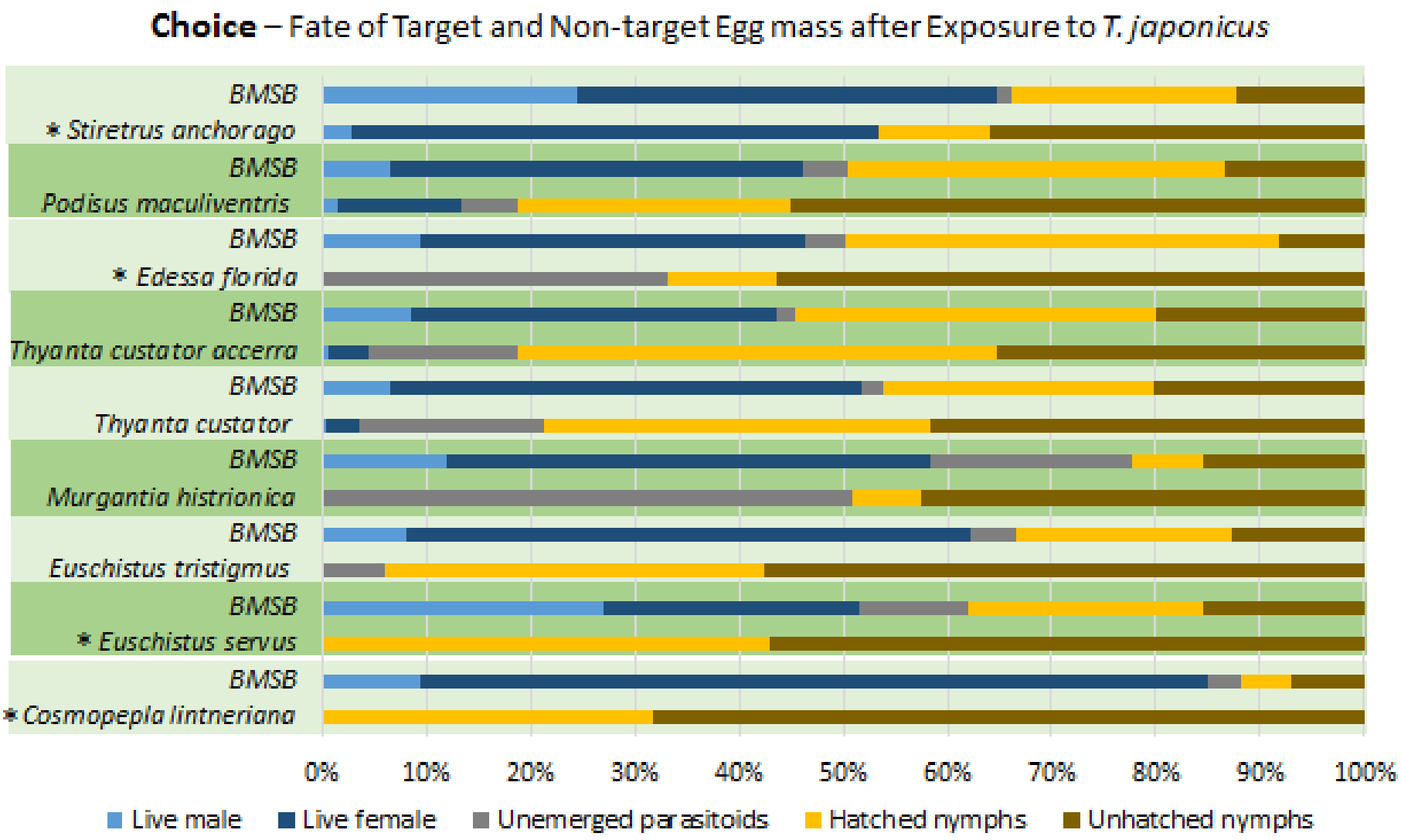


No-Choice Test Outcome (population variability)



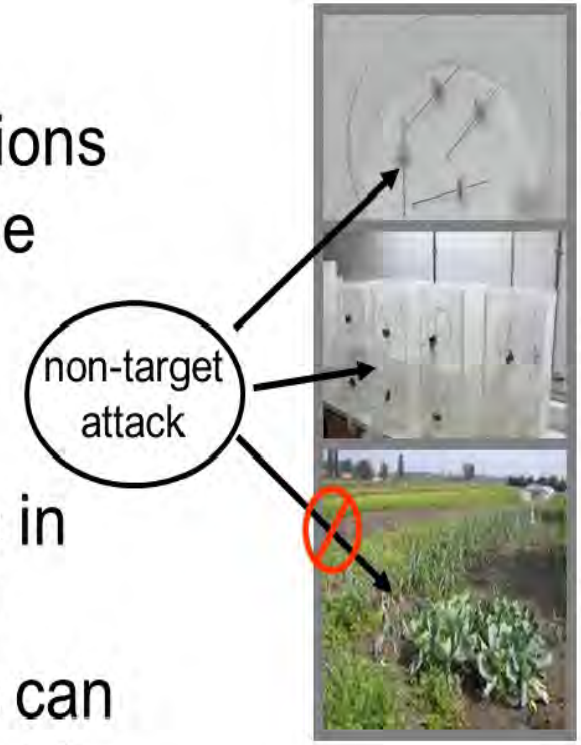
Choice Test Outcome

(as of 2015, Newark BIIR)



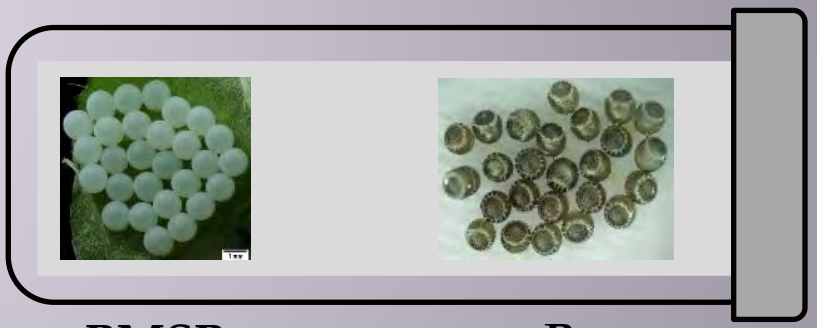
Caveat: Laboratory vs. Field Results

- Laboratory conditions are artificial & false positives likely
- Field experiments in area of origin and behaviour studies can provide the context for interpretation



Slide: Courtesy of P. Mason

Influence of Exposure Time on Host Choice

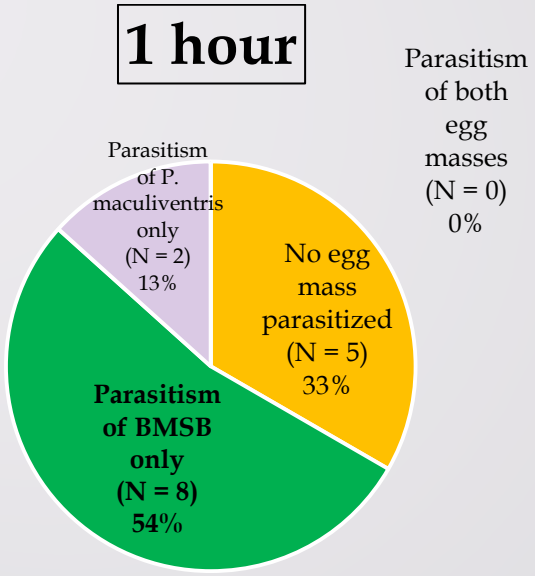


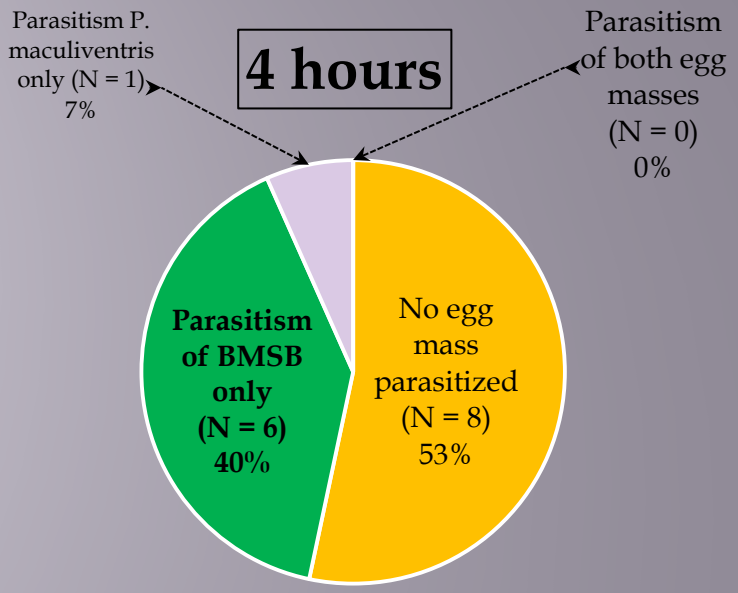
BMSB ***P. maculiventris***

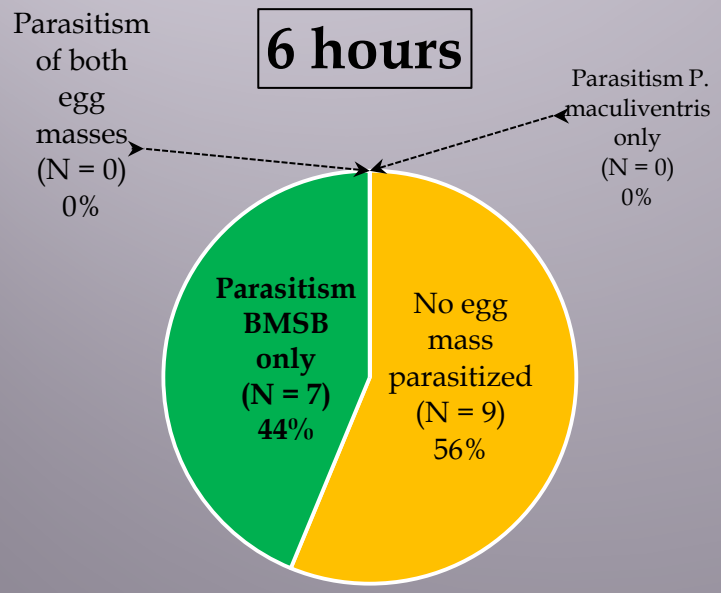
Naïve, 24h-old female *T. japonicus* exposed to egg masses

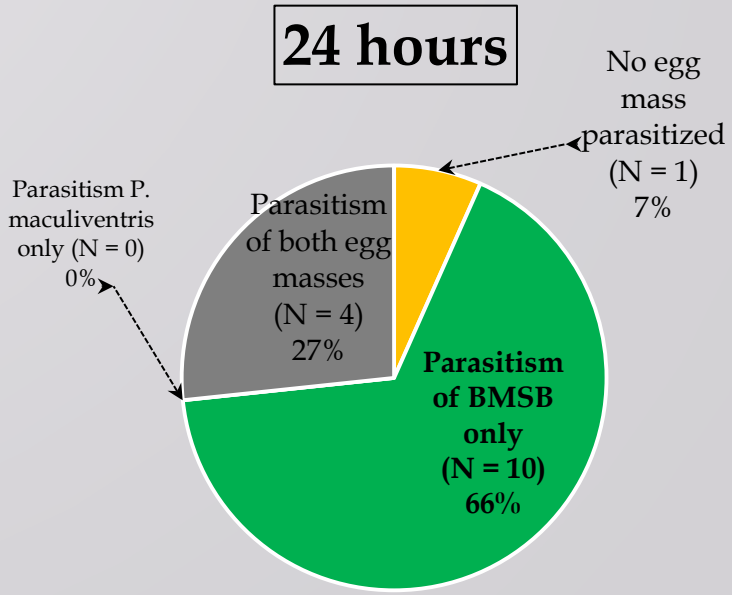
- 1 hour
- 4 hours
- 6 hours
- 24 hours

Observation of parasitoid behavior for 1 hour


1 hour
Parasitism of both egg masses (N = 0) 0%
Parasitism of P. maculiventris only (N = 2) 13%
No egg mass parasitized (N = 5) 33%
Parasitism of BMSB only (N = 8) 54%


4 hours
Parasitism P. maculiventris only (N = 1) 7%
Parasitism of both egg masses (N = 0) 0%
Parasitism of BMSB only (N = 6) 40%
No egg mass parasitized (N = 8) 53%

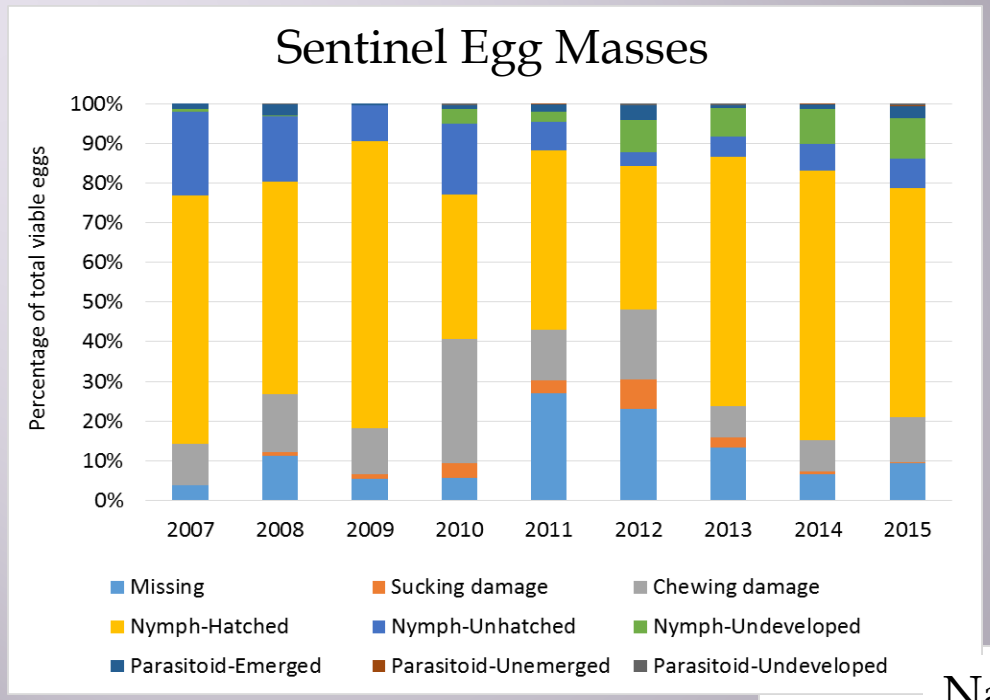

6 hours
Parasitism of both egg masses (N = 0) 0%
Parasitism P. maculiventris only (N = 0) 0%
Parasitism BMSB only (N = 7) 44%
No egg mass parasitized (N = 9) 56%


24 hours
No egg mass parasitized (N = 1) 7%
Parasitism P. maculiventris only (N = 0) 0%
Parasitism of both egg masses (N = 4) 27%
Parasitism of BMSB only (N = 10) 66%

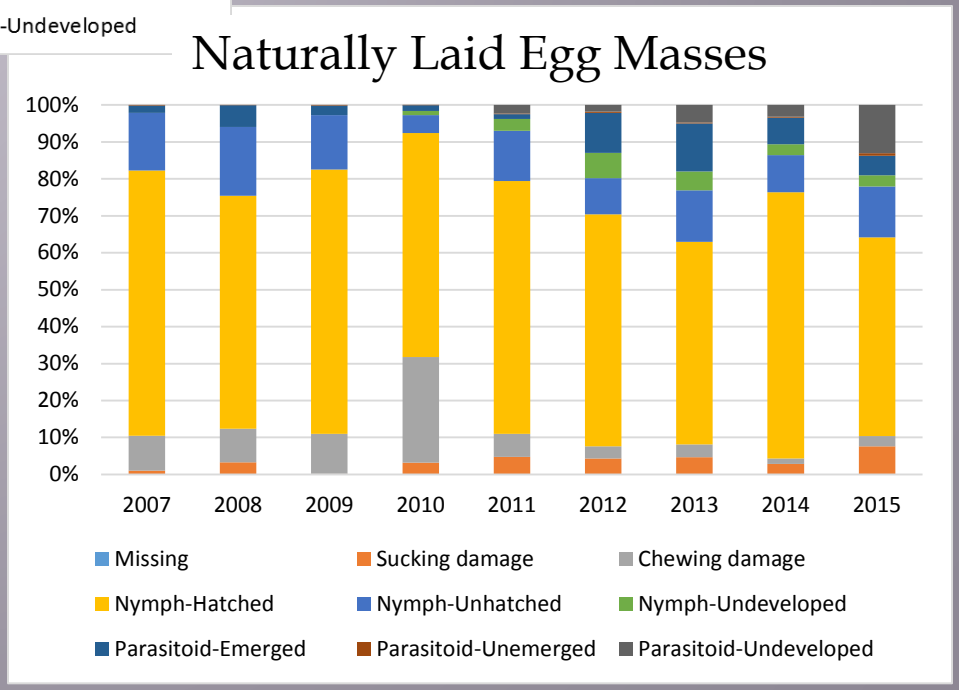
Summary

- Native parasitoids have low impact in landscape reservoirs but may be important in certain crops/situations (e.g., *Anastatus, Telenomus*)
- *T. japonicus* is established and spreading in the U.S. in arboreal landscape habitats (important as population reservoirs)
- Physiological host range of *T. japonicus* includes other stink bug species in the U.S. (in laboratory tests)
- Ongoing studies: ecological impact on non-target pentatomids, including *Podisus maculiventris*
- Impact of both native & introduced natural enemies should increase over time

Thanks for your attention!

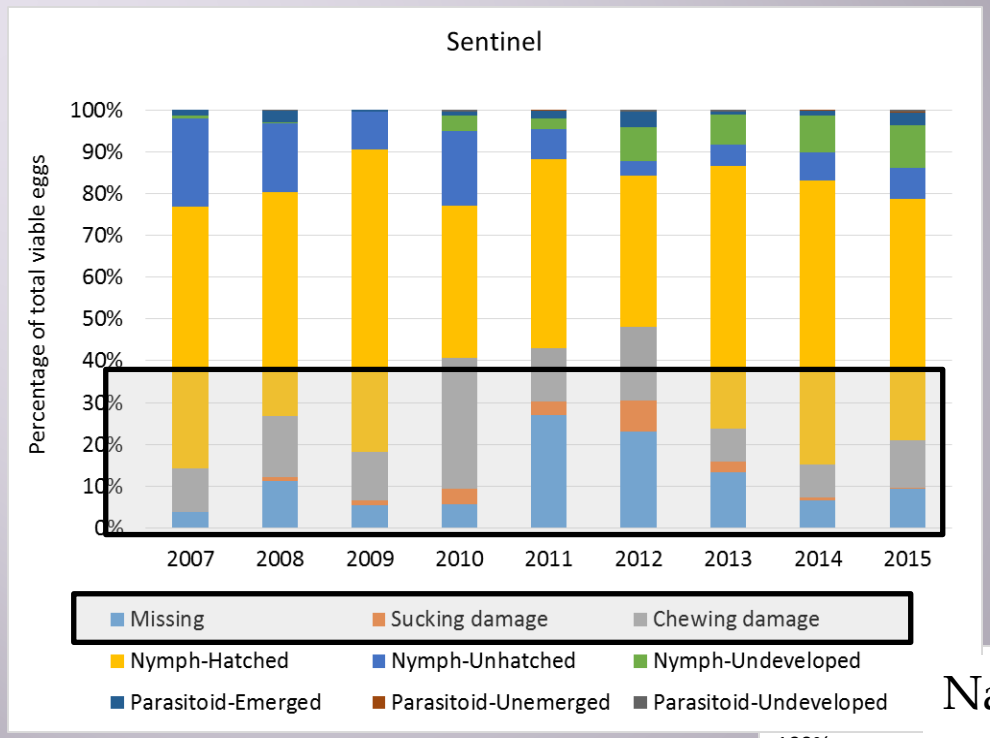


Fate of BMSB eggs in DE surveys 2007 to 2015



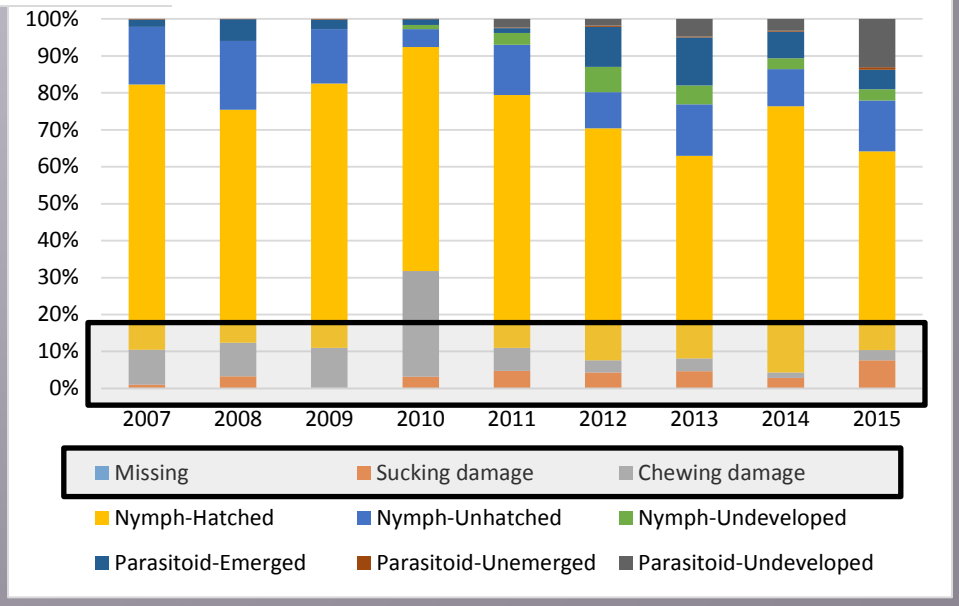
Sentinels vs. naturally laid (wild)

Fate of BMSB eggs in DE surveys 2007 to 2015

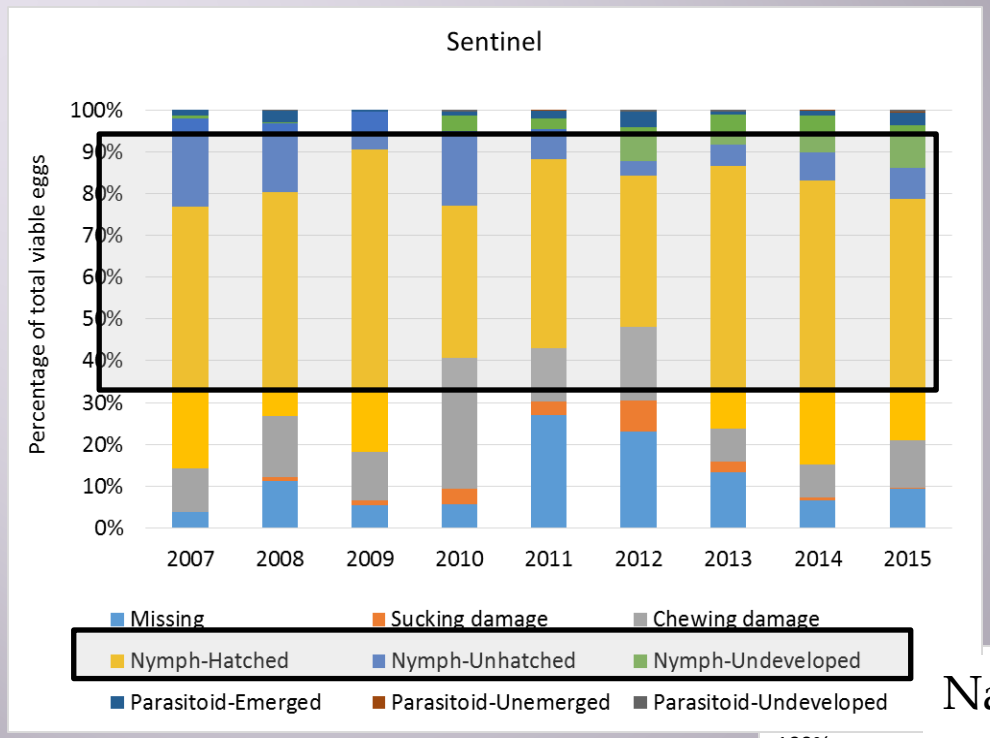


Missing or apparent predation

Naturally Laid Egg Masses

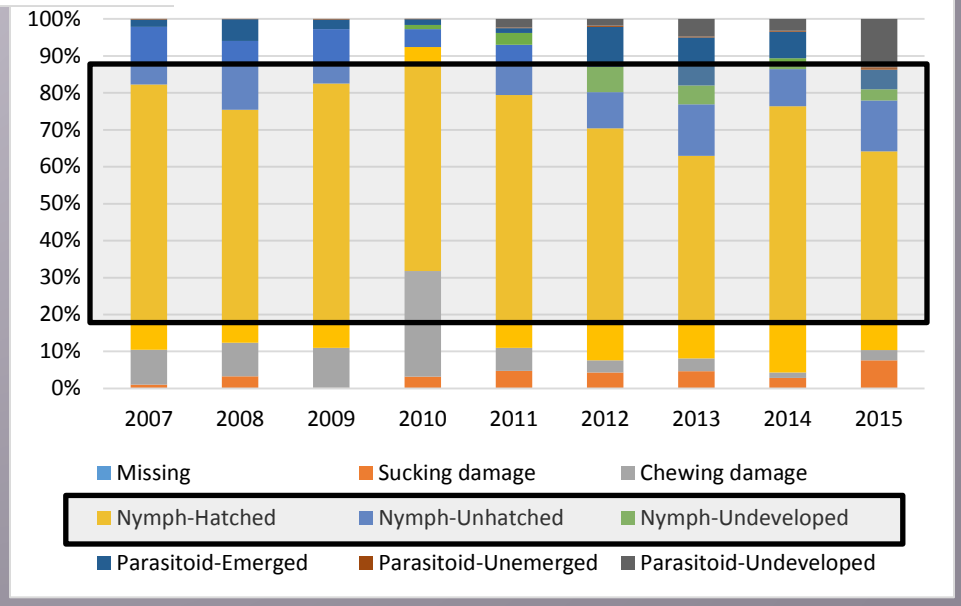


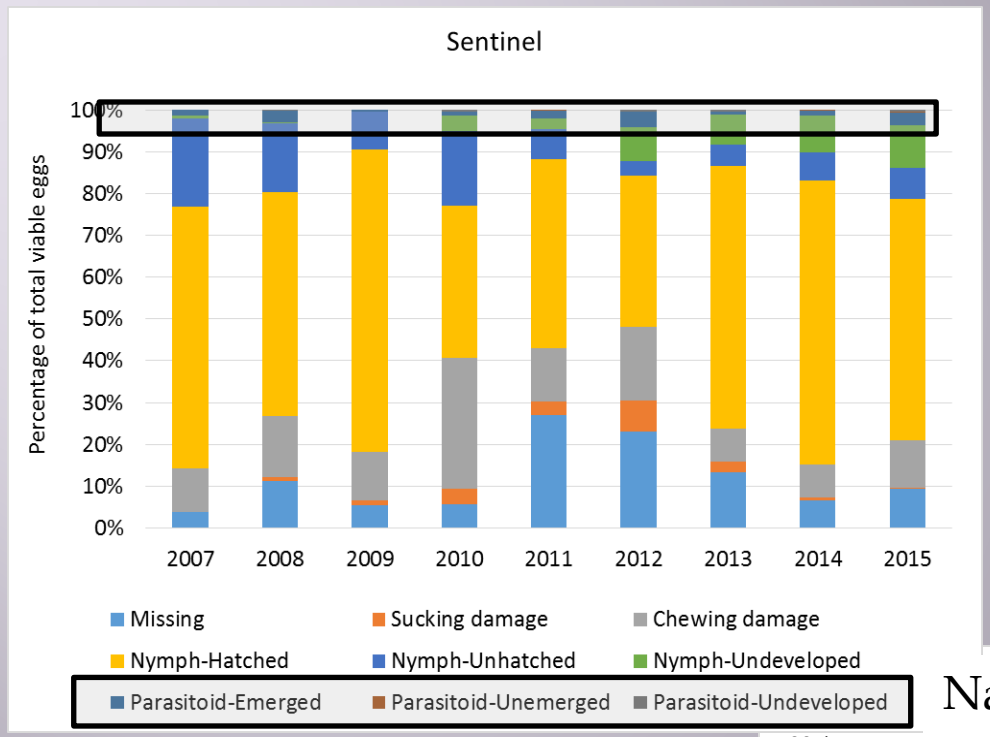
Fate of BMSB eggs in DE surveys 2007 to 2015



BMSB nymphs (hatched & unhatched)

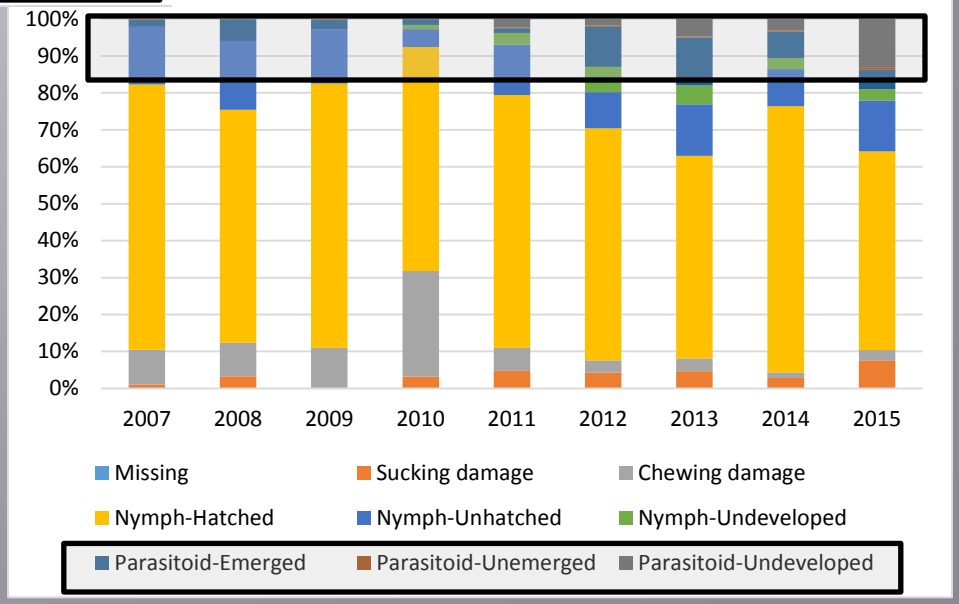
Naturally Laid Egg Masses





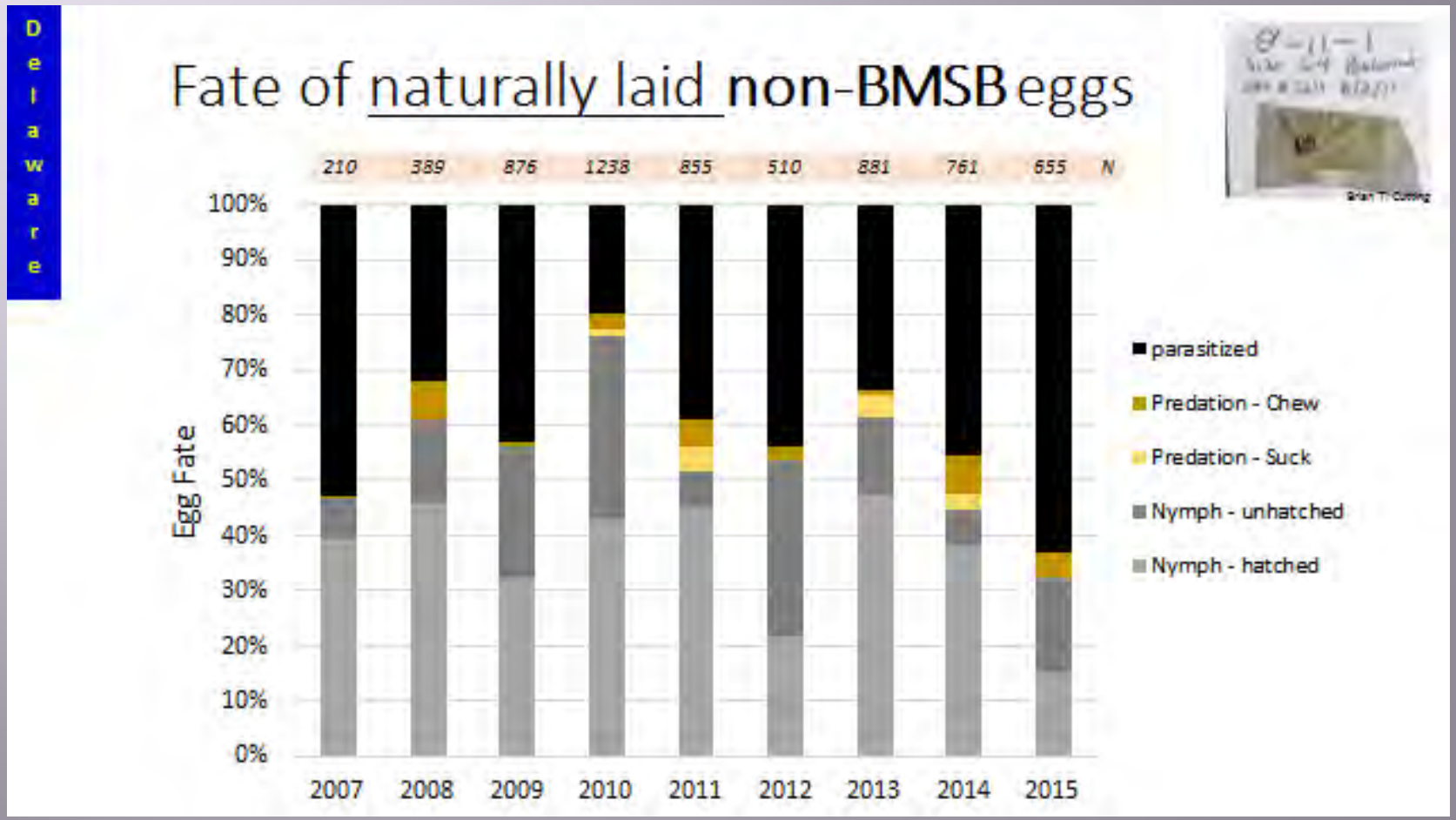
Fate of BMSB eggs in DE surveys 2007 to 2015

Naturally Laid Egg Masses

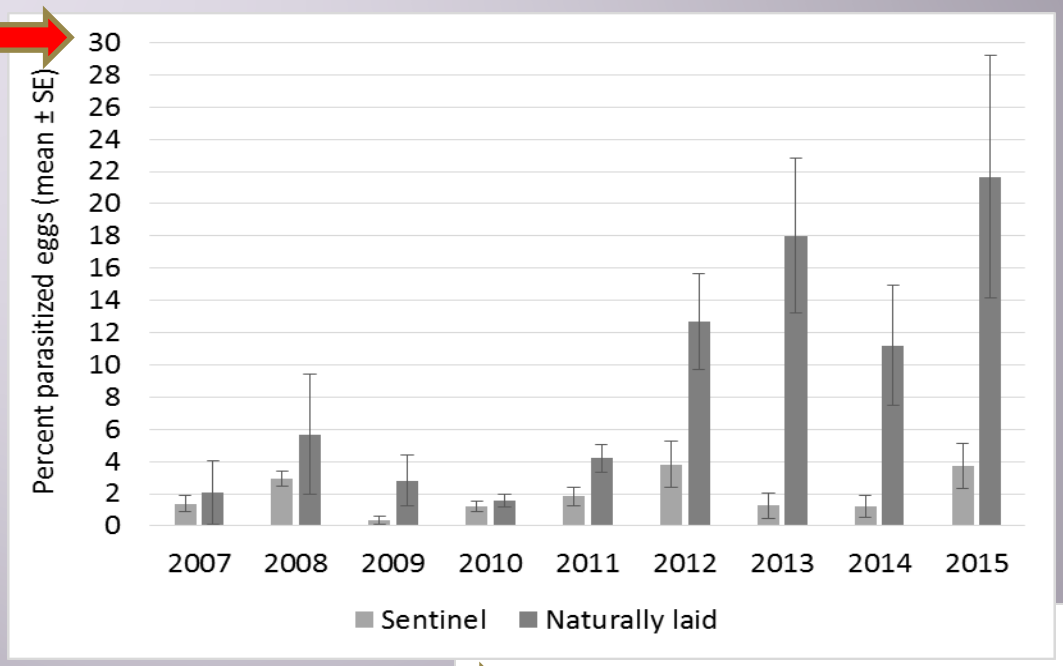


Parasitism (emerged & unemerged)

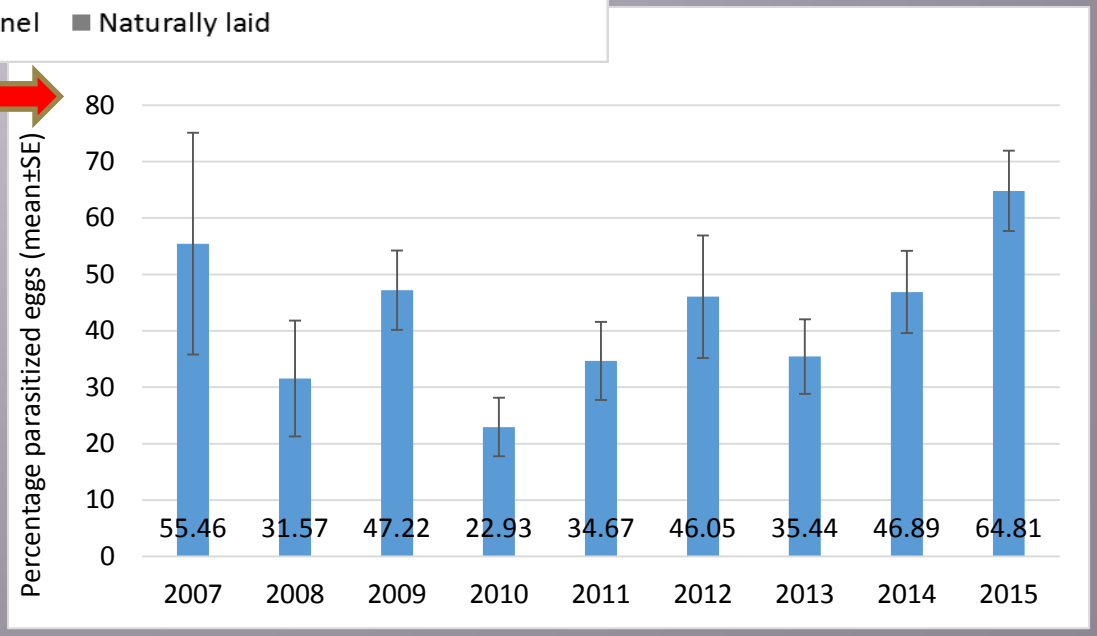
Compare with parasitism rates on native US pentatomids:



Note differences in Y-axis scale

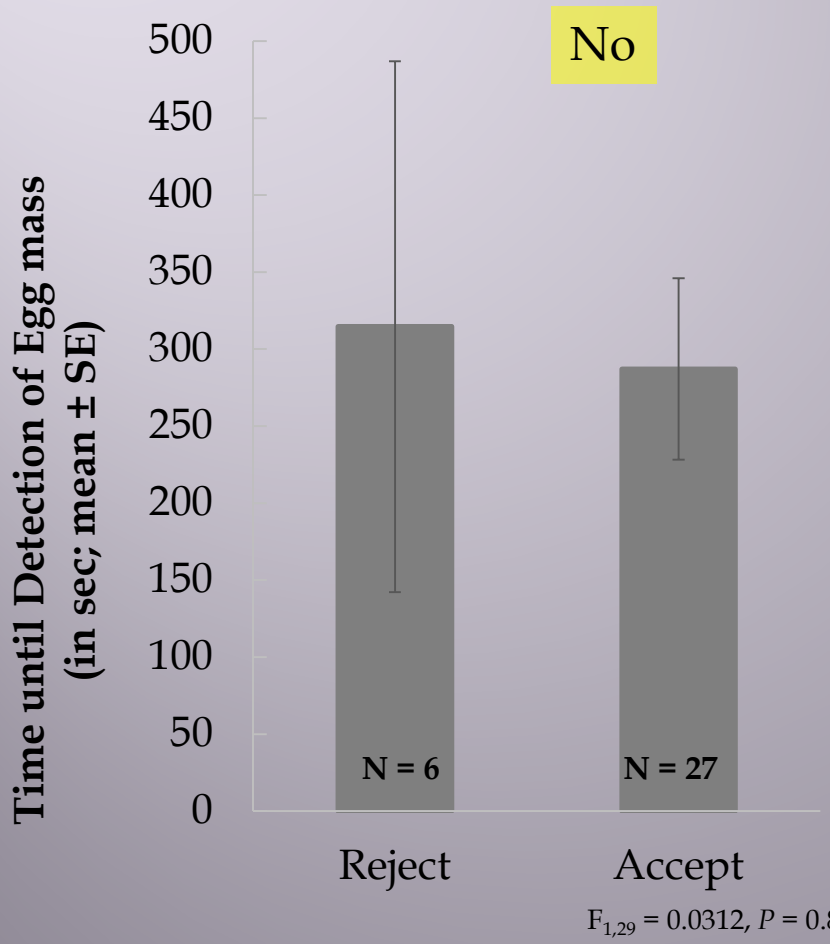


Sentinel BMSB eggs (light grey) & naturally laid BMSB eggs (dark grey): **% eggs parasitized in each egg mass** (± SE)

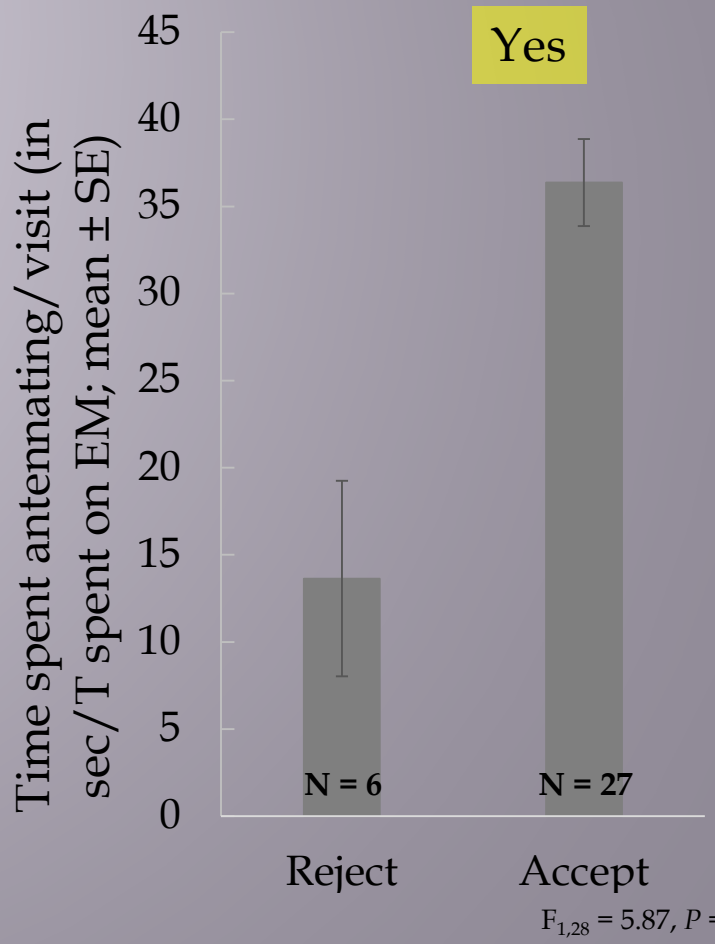


Naturally laid eggs of *other species* (blue): **% parasitized per egg mass** (± SE)

Correlation of Female Behavior with Acceptance?



$F_{1,29} = 0.0312$, $P = 0.861$



$F_{1,28} = 5.87$, $P = 0.0224$

Oviposition (mean ± SE): 168.65 ± 11.5 s
Marking (mean ± SE): 22.65 ± 2.32 s