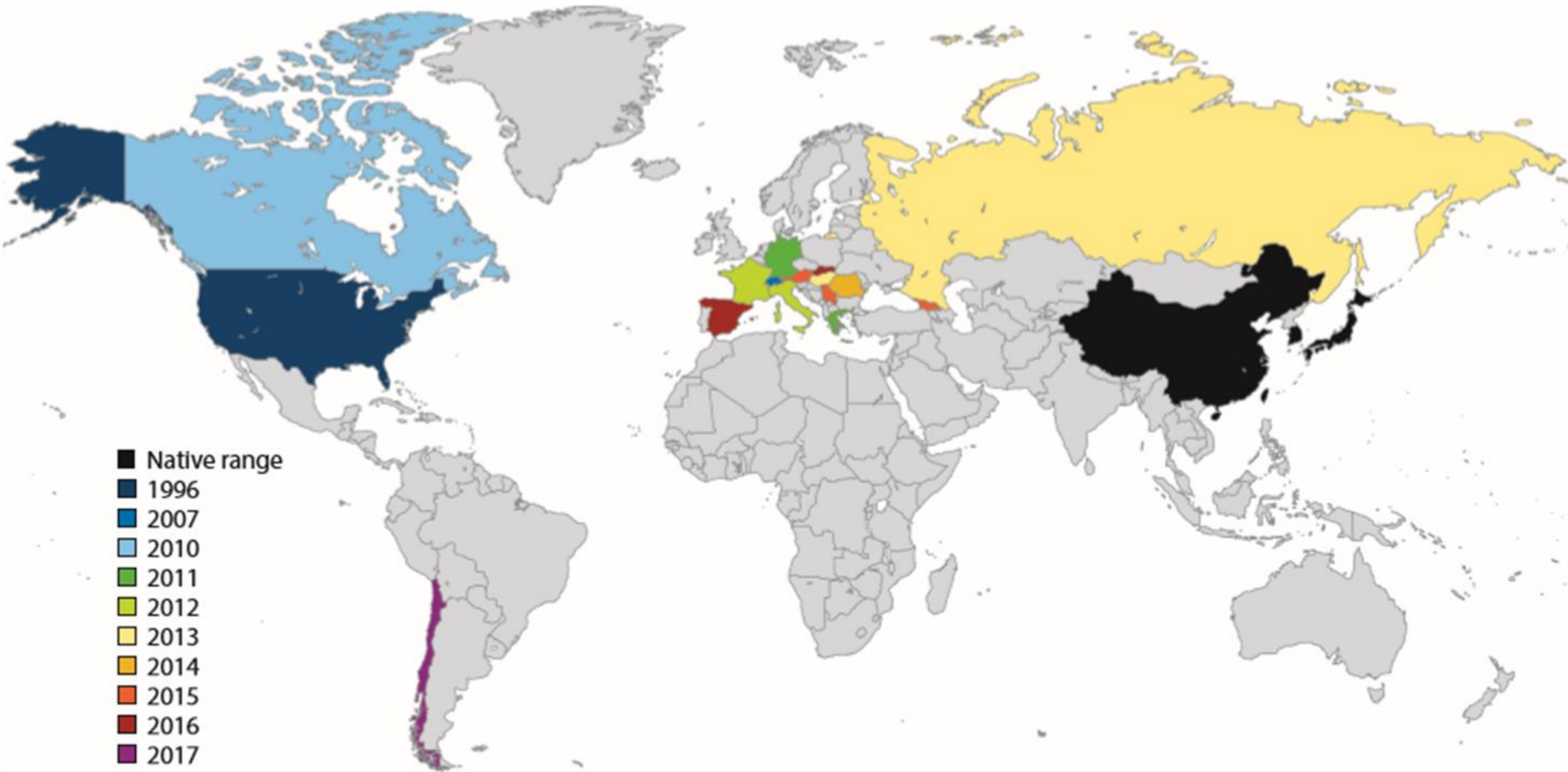

“Biology and field surveys of the invasive
Halyomorpha halys
and its potential native antagonists in Italy”

Candidate: Elena Costi
Tutor: Dr. Lara Maistrello
Co-tutor: Tim Haye



Distribution

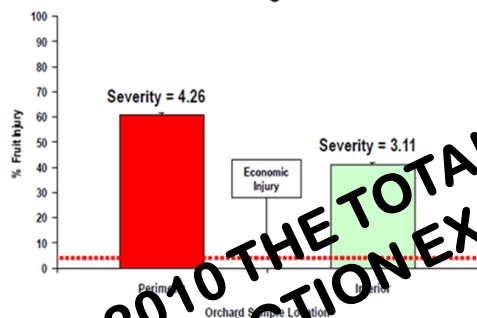


Leskey TC, Nielsen AL (2018) Impact of the Invasive Brown Marmorated Stink Bug in North America and Europe: History, Biology, Ecology, and Management. *Annu Rev Entomol* 63. doi: 10.1146/annurev-ento-020117-043226

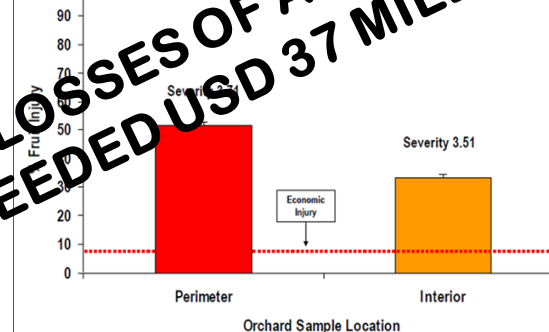
A pest of global concern



BMSB Feeding Injury—Rate and Severity
Regional Commercial Apple Orchards
2010 Growing Season



BMSB Feeding Injury—Rate and Severity
Regional Commercial Pear Orchards
2010 Growing Season



IN 2010 THE TOTAL LOSSES OF APPLE PRODUCTION EXCEEDED USD 37 MILLION

- DISPERSAL CAPACITY
Disruption of the Integrated Pest Management
- POPULATION GROWTH
one or two generations/year
- ABSENCE OF CO-EVOLUTED RELATIONSHIP
WITH NATURAL ENEMIES COMMUNITY



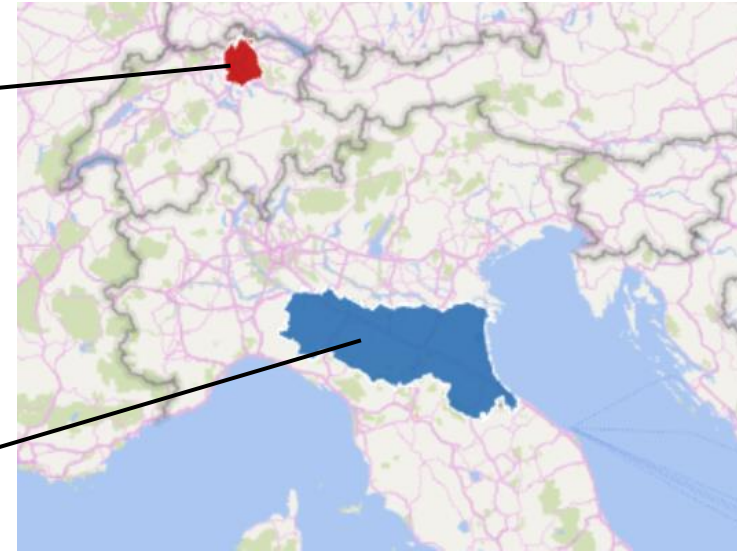
In Europe

Zurich, 2007 (Wermelinger et al. 2008)

(Haye et al. 2014)

Univoltine population, rarely damaging vegetable gardens

Modena, 2012 (Maistrello et al. 2016)



One of the most important region in Europe in terms of fruit and wine productions, providing 25 % of the Italian fruit production and exporting fruits for more than 446 million Euro (Fanfani and Pieri 2016)



Biological parameters:

- Overwintering mortality
- Life table parameters



Biological parameters : overwintering mortality

OCTOBER- DECEMBER

- n=1367 and n= 419 bugs collected in 2015 and 2016 respectively
- All the bugs were placed in wood cages exposed to the external conditions
 - T and RH were recorded

FROM JANUARY

EVERY 48h

- n° bugs outside the overwintering boxes
- n° of bugs died before the first egg laying

The overwintering boxes were opened to evaluate the n° of bugs dead inside



Biological parameters : life table parameters



Cohort of adults reproductive
mature was randomly chosen
among the successful
overwintered adults

**Natural conditions;
food ad libitum
T and RH recorded**

DAILY FOLLOWED FOR...

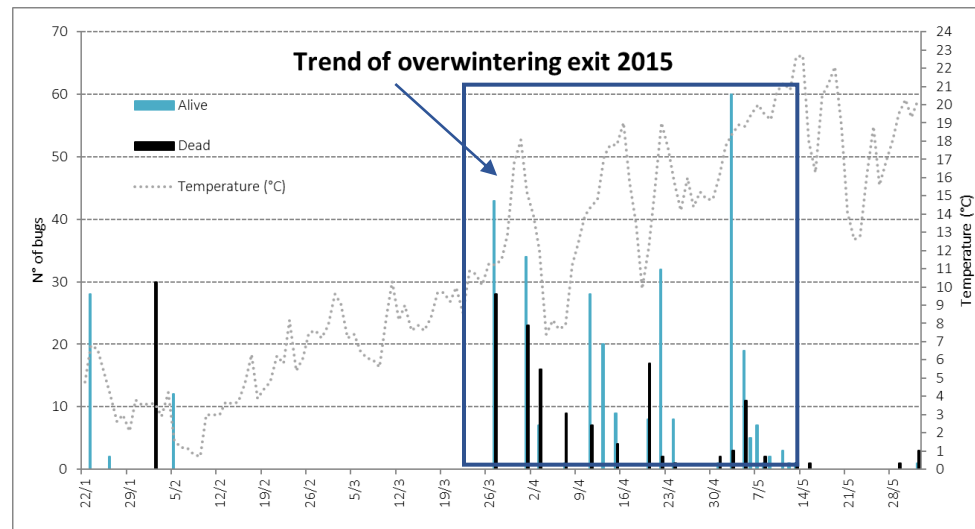
- Fecundity
- Mortality
- Development rate from
eggs to adults



The same procedure was applied
for each generation

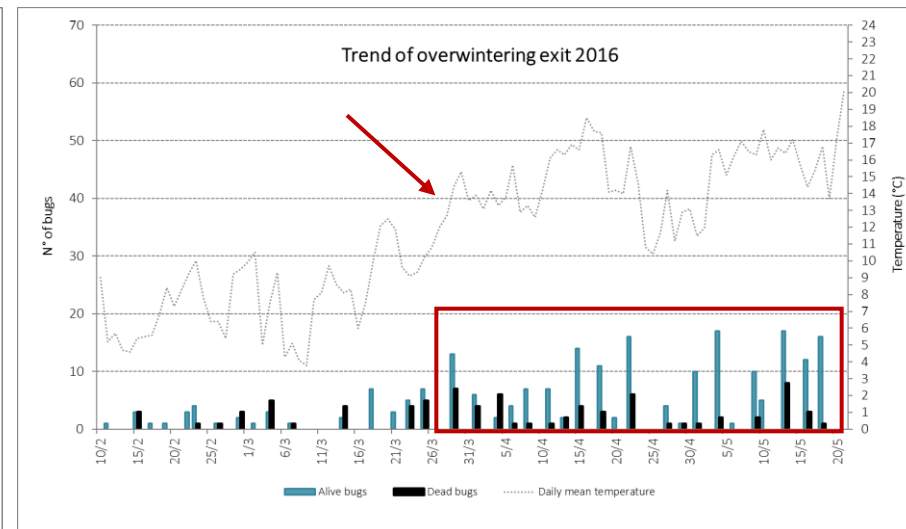


Biological parameters : Overwintering mortality results



2015

- 28% survived overwintering period
- 14% survived until the first egg-laying

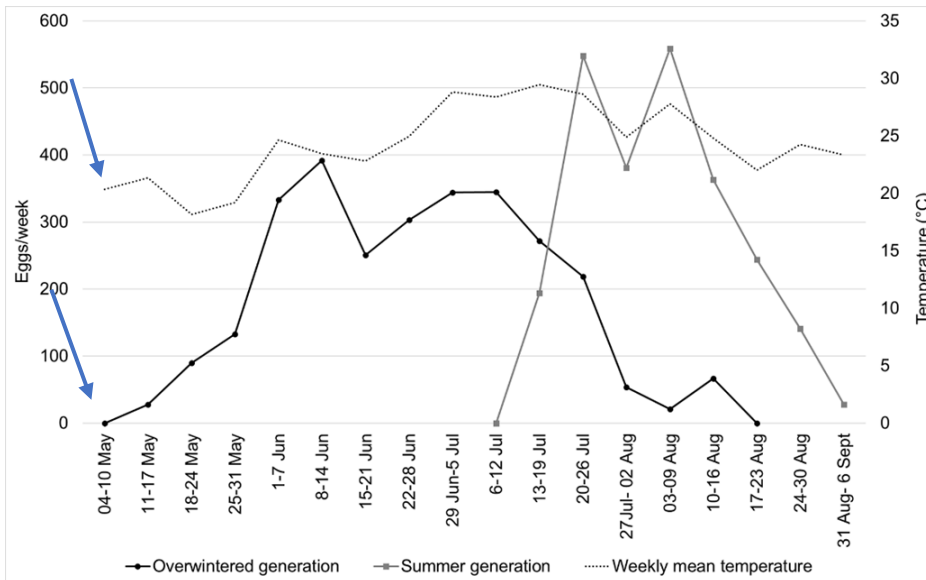


2016

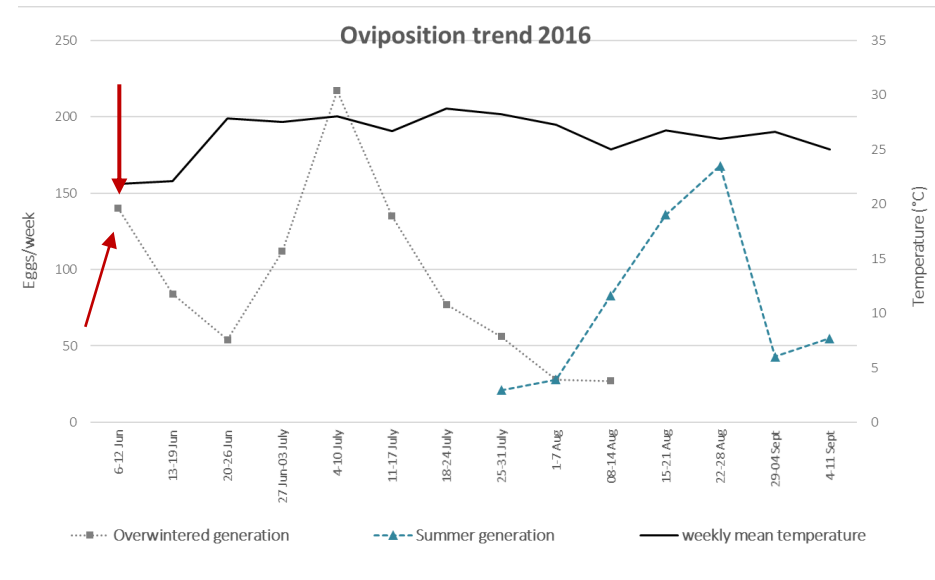
- 64. 48% bugs successfully overwintered
- 40.57 % bugs survived until the beginning of reproductive period

Biological parameters: results of oviposition trend

TWO GENERATION/YEAR



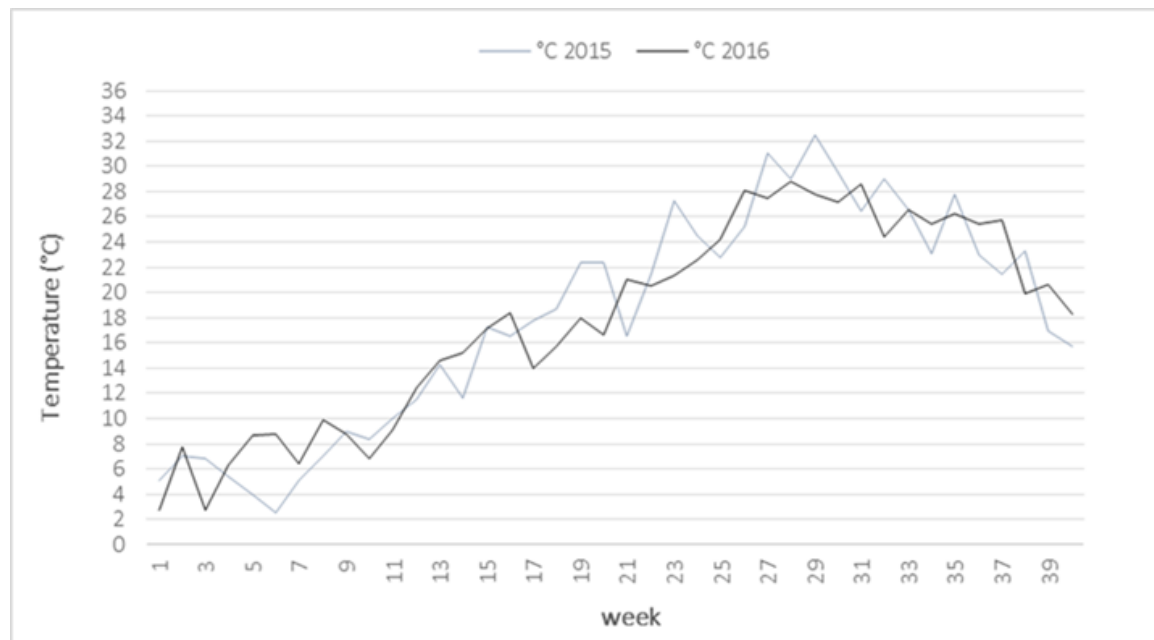
- Starting from July 19 the overlap of overwintered and I generation were observed
- I adult of II generation emerged on August 24
- Latest overwintered couples died on Aug 24



- Lack of the overlapping of overwintered and I generation
- I adult of II generation emerged on September 23
- Latest overwintered couples died on Aug 16

Biological parameters: results of the life table parameters

	Overwintered generation		First generation	
	2015	2016	2015	2016
Realized fecundity	110.41	51.67	214.69	21.36
R0	24.04	2.41	5.44	0.03
Total mortality %	56.46	90.68	97.47	99.71



Costi E, Haye T, Maistrello L (2017) Biological parameters of the invasive brown marmorated stink bug, *Halyomorpha halys*, in southern Europe. *J Pest Sci* 90:1059–1067. doi: 10.1007/s10340-017-0899-z

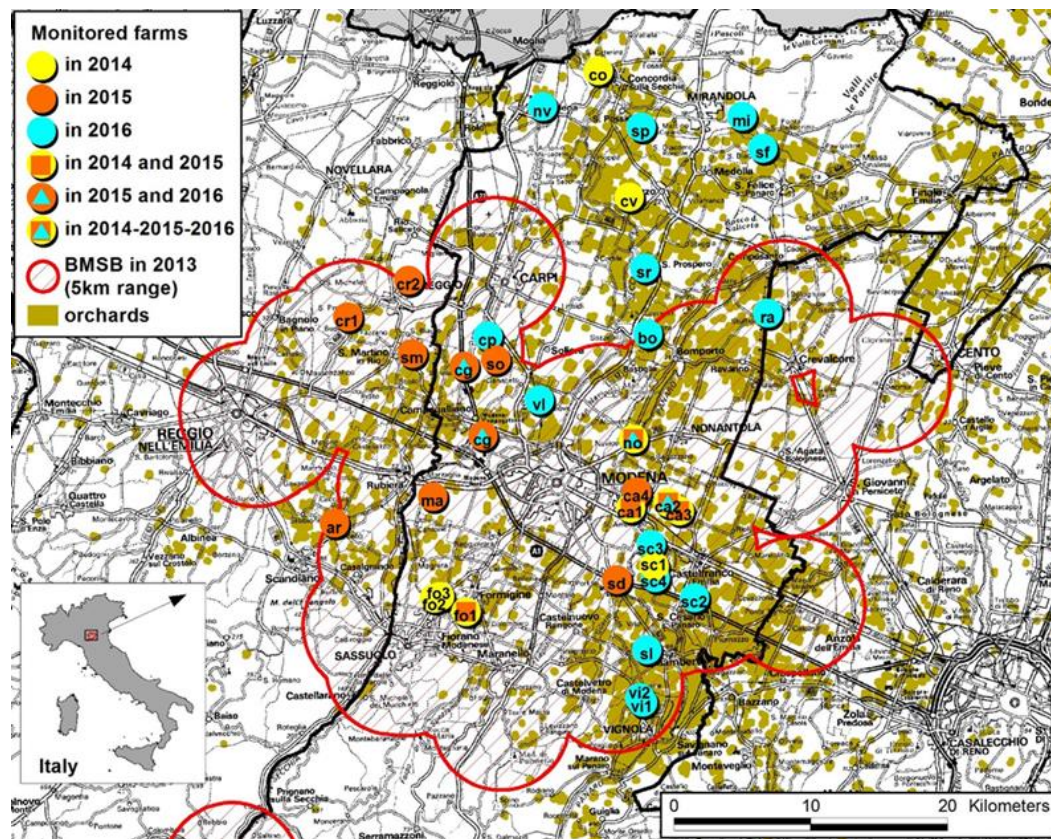
Monitoring regards the seasonal abundance and impact of the BMSB and other Heteroptera species within the orchards



Monitoring program

Were monitored

- 10 farms in 2014
 - 14 in 2015
 - 18 in 2016
- 2-3 ha in size
 - close (< 20 m) to a building (house/barn) and
 - to a grassy area (mixed herbaceous plants, mostly Poaceae, or alfalfa crops)
 - managed according to the Regional IPM guidelines (Regione Emilia Romagna 2016)

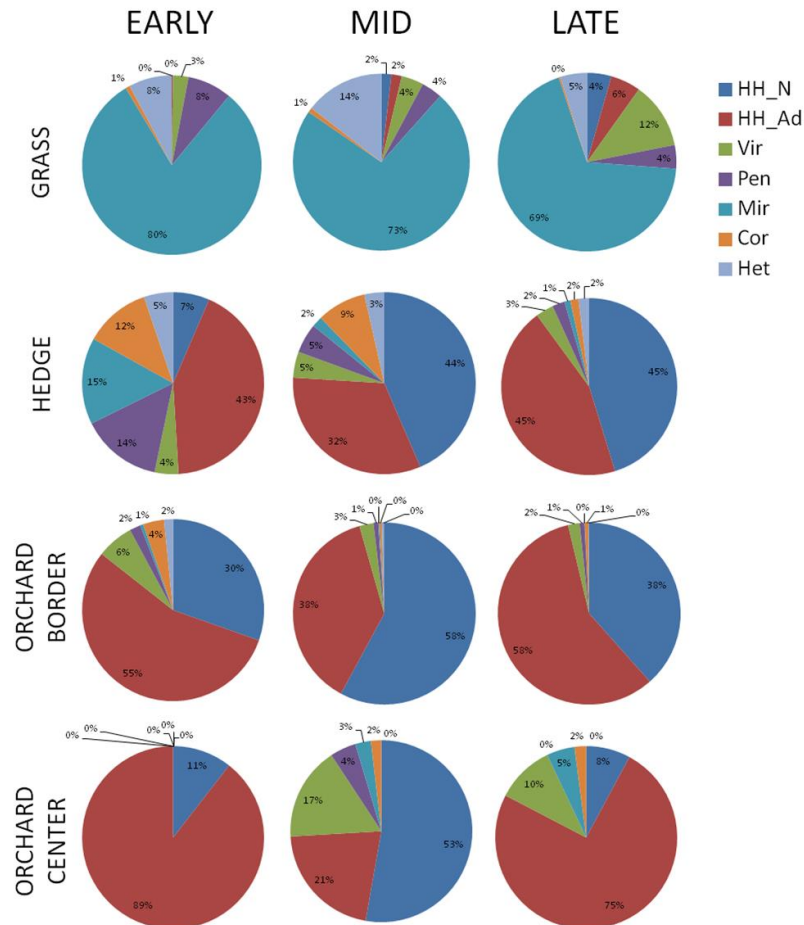


a) Visual sampling: 2 min. observations on five randomly chosen trees/shrubs, inspecting all leaves, fruits and woody parts between 1-2 m above the ground.

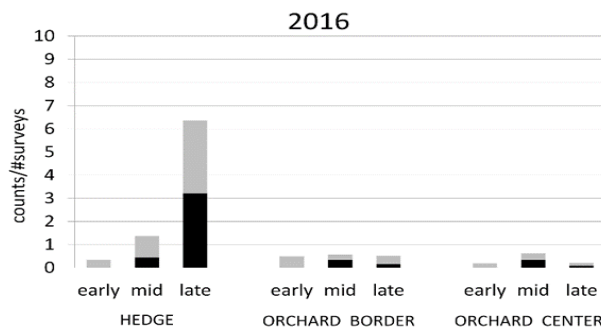
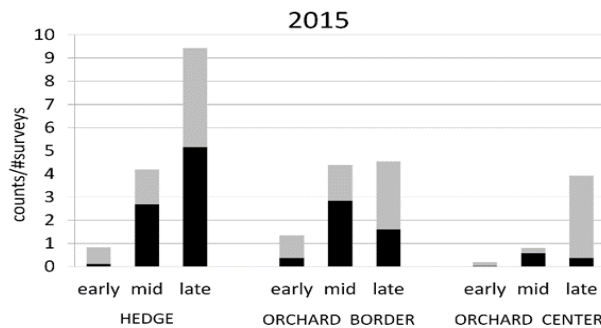
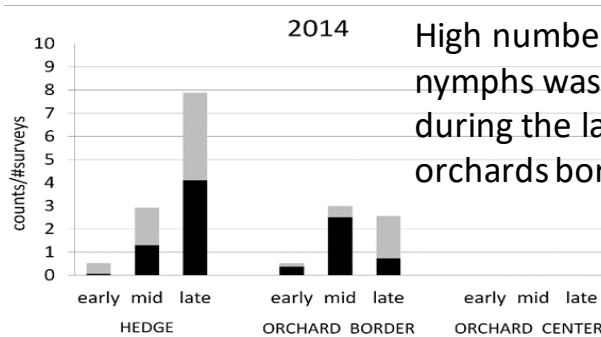
b) Sweep netting: samples were taken using a sweep net (40 cm diameter) during 10 consecutive beats over a 10m row in three different transects.

THE NUMBER OF BMSB AND OTHER HETEROPTERA SPECIES WERE RECORDED

- BMSB was the most abundant species representing the 38.2% of all collected species
- Occasionally present in grassy area

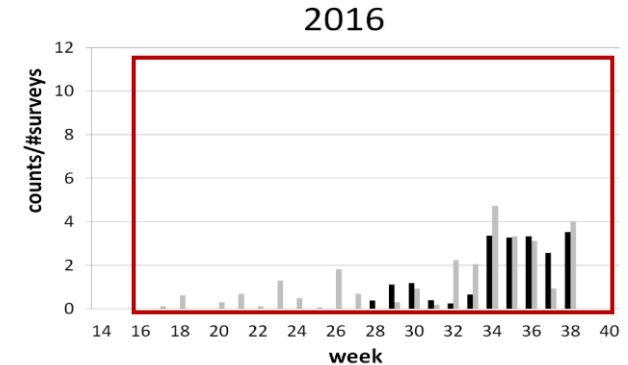
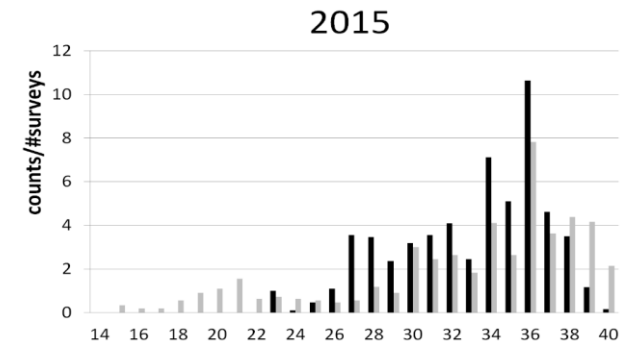
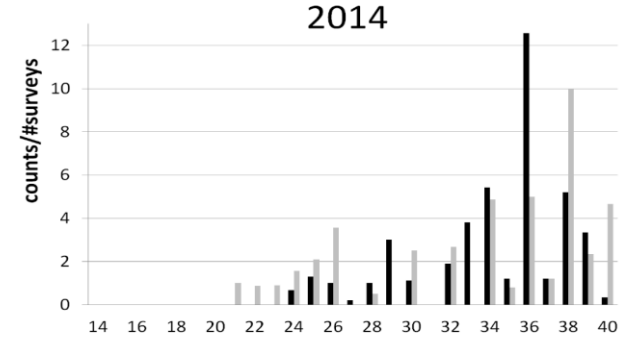


Monitoring program: Results



DAMAGE

- In 2014, damage was 15- 40%, up to 80% in one farm.
- In 2015, the observed damage on pears was never lower than 8%; in nine farms, was higher than 40% and in four of these, greater than 70%.
- In 2016, in five farms of those with available data, damage was higher than 30%.



Survey regards the presence and
efficacy of natural enemies community



Survey of natural enemies community



FRESH SENTINEL EGG MASSES

2014:

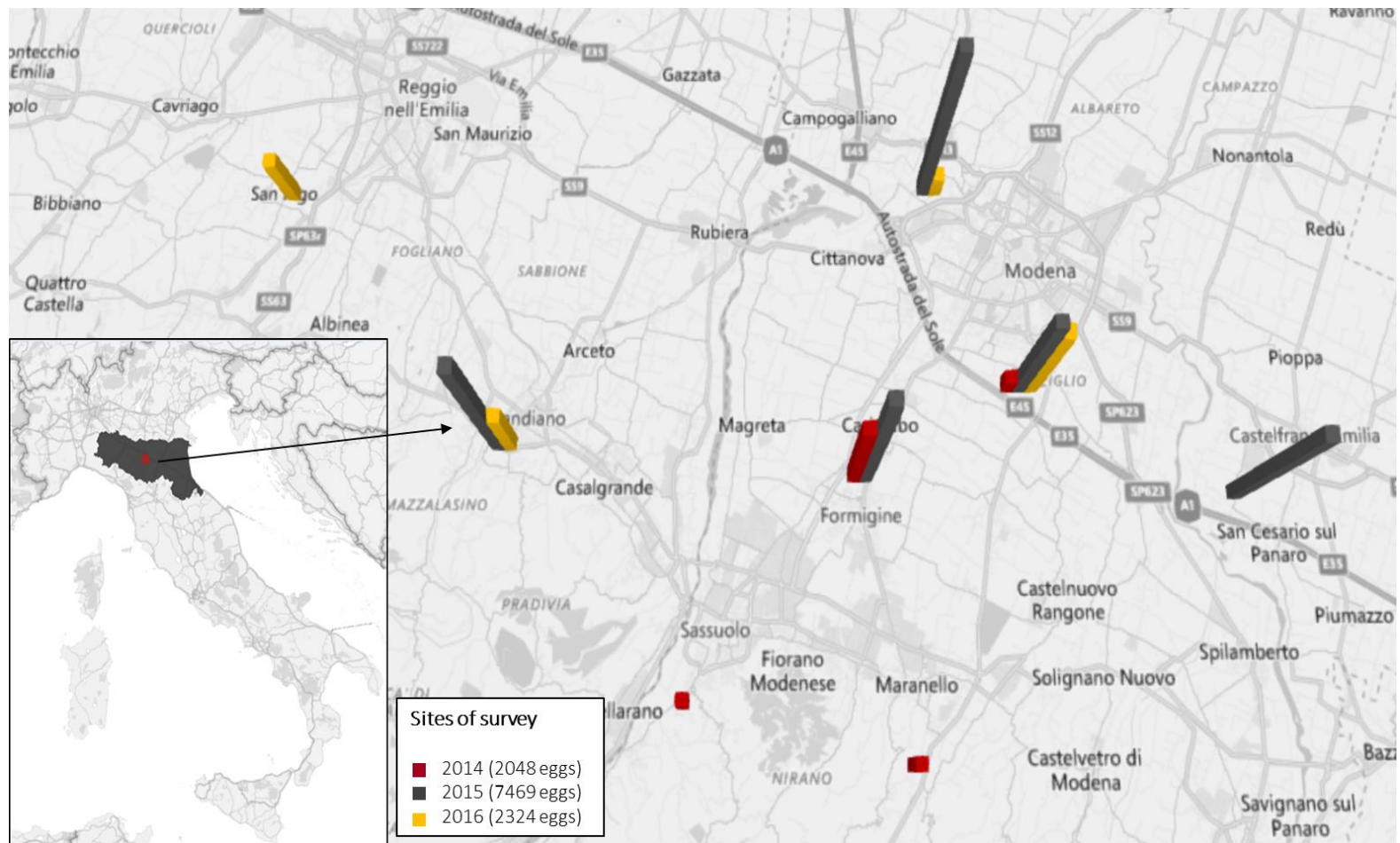
Egg masses fresh collected in laboratory mass rearing were clipped under lower leaf surface

2015-2016:

Eggs were laid directly on plant branches to isolate reproductive adults on plant branches on a sleeve cages



Survey of natural enemies community

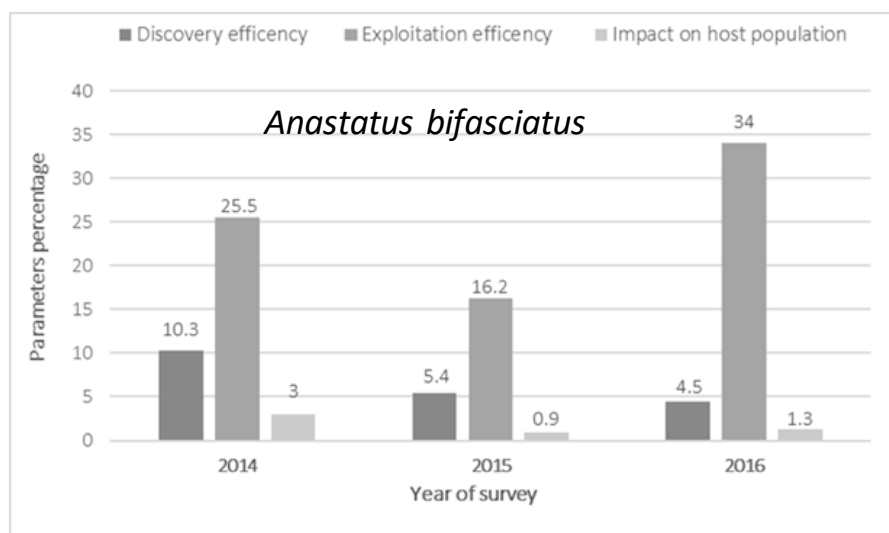


Total number of eggs exposed: 11495

Survey of natural enemies community: Results

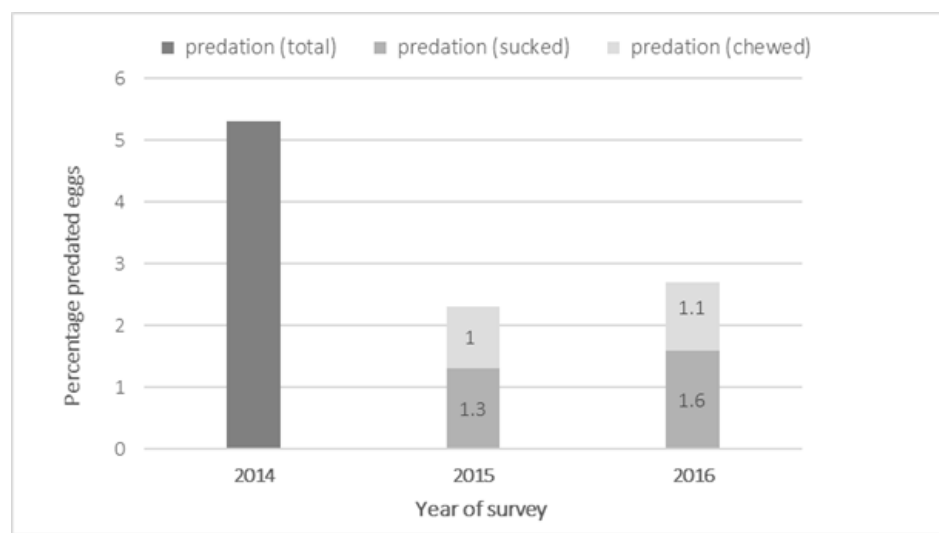
Parasitization:

- Discovery efficiency
- Exploitation efficiency
- Impact on host population



Predation:

Percentage of chewed and sucked eggs



The overall percentages of parasitism and predation were 1.30 and 2.92 respectively

Abram PK, Hoelmer KA, Acebes-Doria A, et al (2017) Indigenous arthropod natural enemies of the invasive brown marmorated stink bug in North America and Europe. J Pest Sci 90:1009–1020. doi: 10.1007/s10340-017-0891-7

GENERAL CONCLUSION

- A severe season-long pest for the northern Italian fruit productions
- High level of damage significantly related to its abundance
- Two generation/year
- Population dynamic strongly affected by the temperature
- Low impact of egg-parasitoids and predators



This studies represent:

- a baseline for future integrated pest management strategies
- a starting point for further investigations on the role of predators
- base for the integration of the mortality caused by antagonists with the parameters obtained in the life table studies
- base for the development of populations dynamic models in order to support and optimize sustainable management strategies

Thank you for your attention

