ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

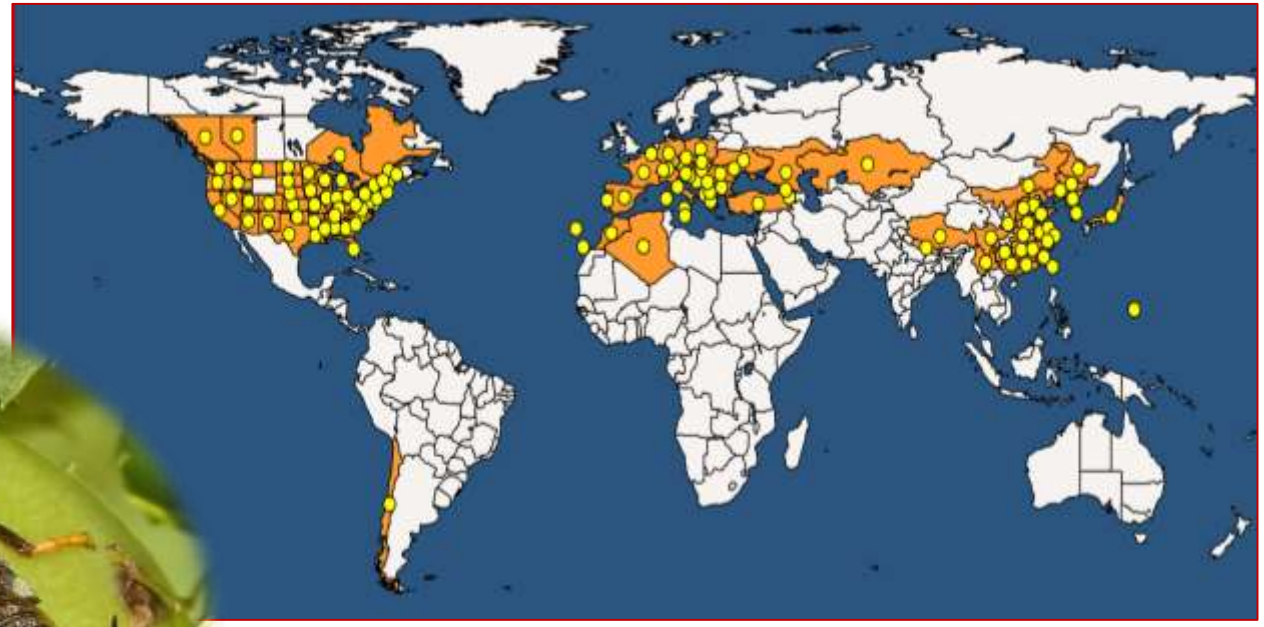
EFFECTS OF *TRISSOLCUS JAPONICUS* RELEASES ON THE DISTRIBUTION AND PARASITISM RATE OF *HALYOMORPHA HALYS* EGG PARASITOIDS IN EMILIA-ROMAGNA REGION, NORTHERN ITALY

A. Masetti[1], E. Costi[2], F. Lami[1], A. Zaniboni[1], M. Ceccarelli[1], D. Torreggiani[1], G. Vaccari[3], S. Caruso[3], M. Preti[4], L. Fagioli[5], F. Manucci[5], R. Ferrari[6], M. Bariselli[7], M. G. Tommasini[8], G. Burgio[1], L. Maistrello[2]

[1] Department of Agricultural and Food Science, University of Bologna, Italy
[2] Department of Life Sciences, University of Modena and Reggio Emilia, Italy
[3] Consorzio Fitosanitario Provinciale di Modena, Italy
[4] Astra Innovazione e Sviluppo. Faenza (FC), Italy
[5] Consorzio Agrario di Ravenna. Cotignola (RA), Italy
[6] Centro Agricoltura Ambiente "G. Nicoli", Crevalcore (BO), Italy
[7] Servizio Fitosanitario Regione Emilia-Romagna, Bologna, Italy
[8] Ri.Nova, Cesena, Italy

Halyomorpha halys (Stål) (Hemiptera: Pentatomidae)

- ✓ In Italy since 2007
- ✓ In Emilia-Romagna since 2012



- ✓ Insecticide sprays are not fully effective
- ✓ Increase of the frequency and the amounts of broad spectrum insecticides in the orchards
- ✓ Management strategies also have to tackle the bugs thriving outside crops

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

Economic losses in Emilia-Romagna




- ✓ ≈600 million € in 2019 in Northern Italy on pear, peach, nectarine, apple and kiwifruit
- ✓ Less severe damage but still concerning in the following years:

Journal of Economic Entomology, 114(4), 2021, 1733–1742
doi: 10.1093/jee/toab126
Advance Access Publication Date 5 July 2021
Research

ENTOMOLOGICAL SOCIETY OF AMERICA
SHARING INSECT SCIENCE GLOBALLY

OXFORD

Horticultural Entomology

Halyomorpha halys (Hemiptera: Pentatomidae) on Kiwifruit in Northern Italy: Phenology, Infestation, and Natural Enemies Assessment

Santolo Francati,[1] Antonio Masetti,[1] Riccardo Martinelli, Daniele Mirandola, Giacomo Anteghini, Riccardo Busi, Francesco Dalmonte, Francesco Spinelli, Giovanni Burgio, and Maria Luisa Dindo[1,2]

2020

2021

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

The long path toward the authorisation to release exotic parasitoids

Servizio itosanitario Emilia-Romagna

Regional and central plant protection services

crea
Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria

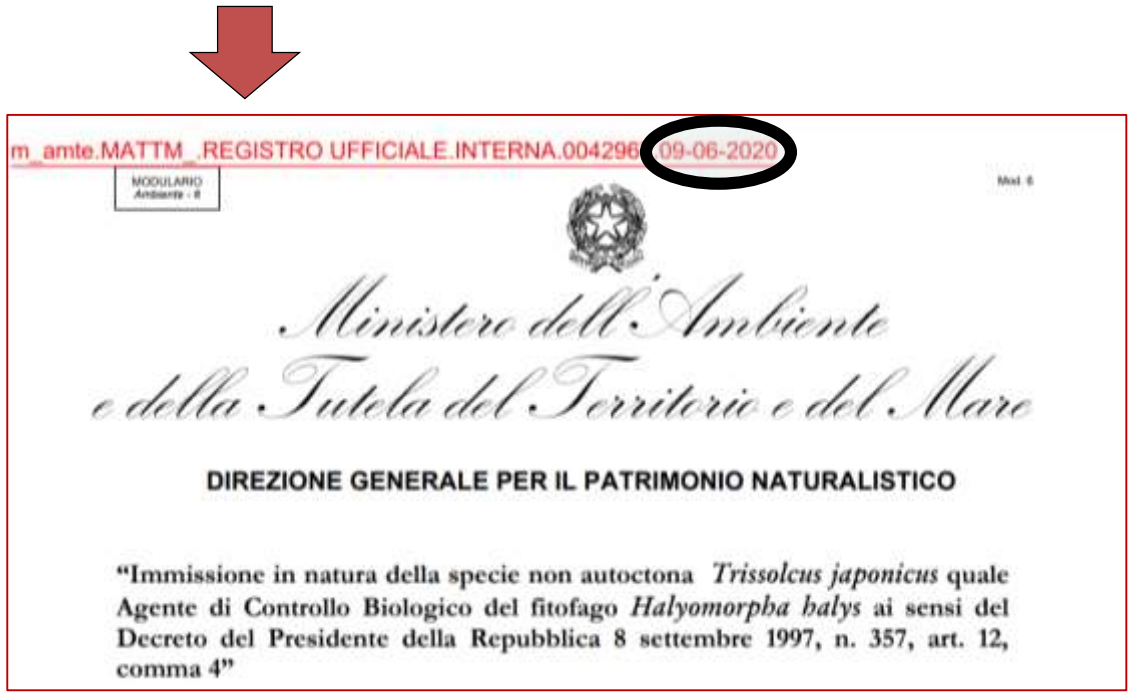
Universities and research centres

Extension services

Farmers' associations

MINISTERO DELL'AMBIENTE E DELLA TUTELA DEL TERRITORIO E DEL MARE

ISPRA


m_amte.MATTM_.REGISTRO UFFICIALE.INTERNA.004296 09-06-2020

MODULARIO Ambiente - 8

Mod. 6

Ministero dell'Ambiente e della Tutela del Territorio e del Mare

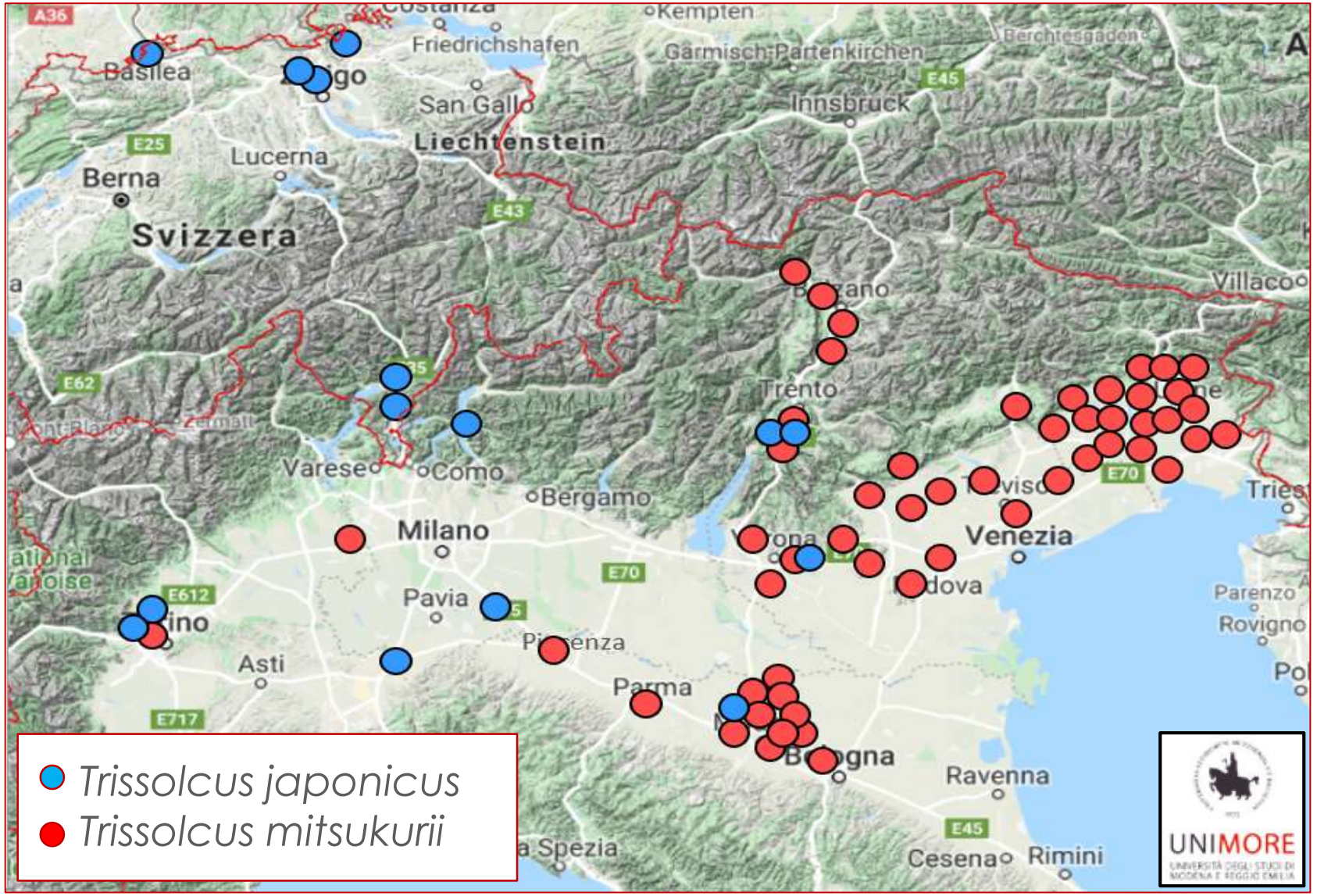
DIREZIONE GENERALE PER IL PATRIMONIO NATURALISTICO

"Immissione in natura della specie non autoctona *Trissolcus japonicus* quale Agente di Controllo Biologico del fitofago *Halyomorpha halys* ai sensi del Decreto del Presidente della Repubblica 8 settembre 1997, n. 357, art. 12, comma 4"

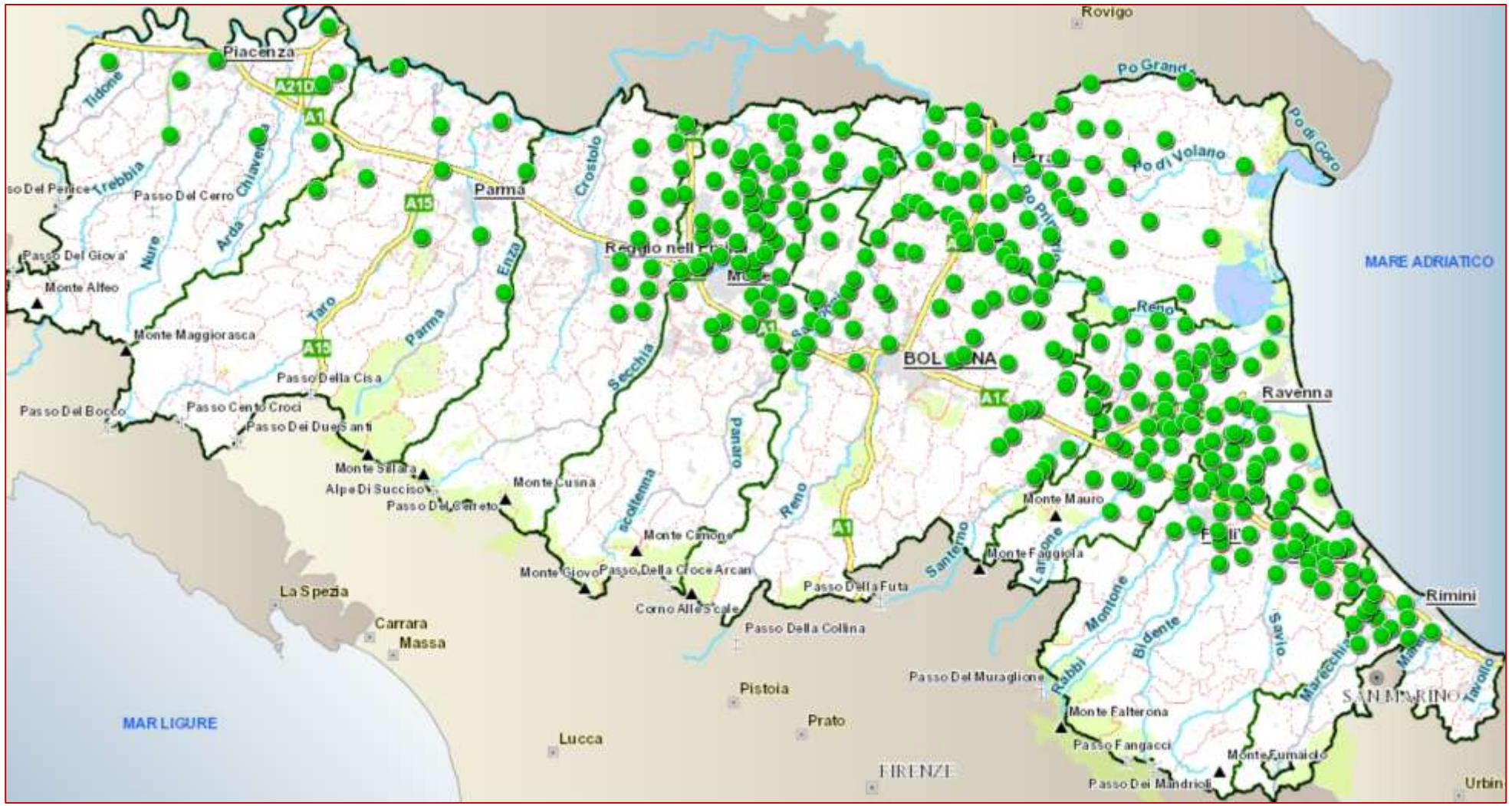
ALMA MATER STUDIORUM UNIVERSITÀ DI BOLOGNA

Trissolcus japonicus (Ashmead)(Hymenoptera: Scelionidae)

- ✓ Adventive populations have been found in Northern Italy since 2018
- ✓ In Emilia-Romagna the first report was in 2019



Classical biological control program in Emilia-Romagna



- ✓ 300 release sites in 2020 and 2022,100 sites in 2021
- ✓ 700 releases, **140 thousand** wasps in total

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

Programma di Sviluppo Rurale dell'Emilia-Romagna 2014-2020

ALMA MATER STUDIORUM UNIVERSITÀ DI BOLOGNA

UNIMORE

Consorzio Agrario di Ravenna

Consorzio Fitosanitario Provinciale di Modena

ASTRA

CAA Centro Agricoltura Ambiente Giorgio Nicoli

RegioneEmiliaRomagna

RINOVA agricoltura ambiente alimentazione

PSR PROJECT: HALY.BIO Surveys for the implementation of biological control of the invasive *Halyomorpha halys* in Emilia-Romagna

Aims:

- Occurrence and impact of parasitoids that exploit eggs of *Halyomorpha halys*.
- Trends of parasitisation by the different species across years (2020-22).
- Distribution of the parasitoids in the region by year

METHODS

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

Searching for stink bug egg masses

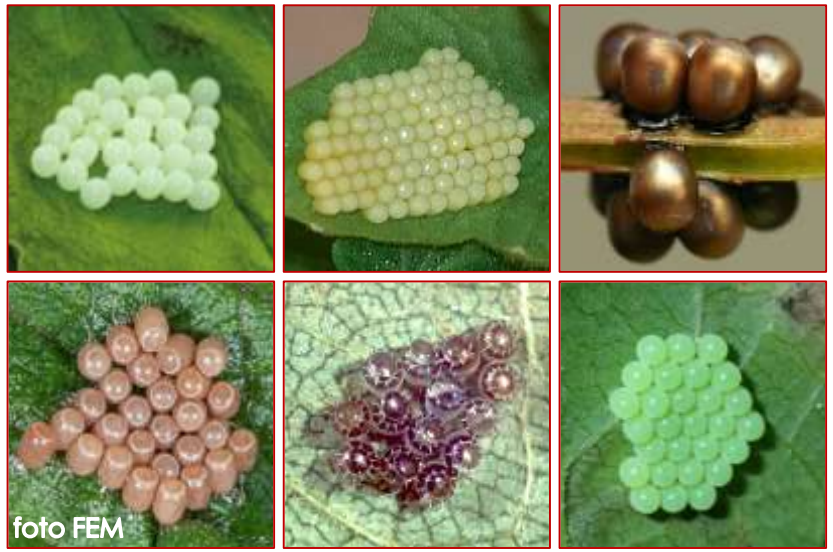
- ✓ 150 sites overall sampled in the Emilia-Romagna region
- ✓ Uncultivated seminatural habitats
- ✓ ≈ in half of the sites *T. japonicus* had been released before samplings
- ✓ 1 h inspection of trees and shrubs once or twice per season
- ✓ All egg masses laid by stink bugs were collected

Egg mass storage

- ✓ After collection. eggs masses were stored at 20-25 °C for a minimum of 60 days to allow bug nymphs and adult parasitoids to emerge

Identifications

Identification of the egg masses



Parasitoid identification

Inspection of the egg masses

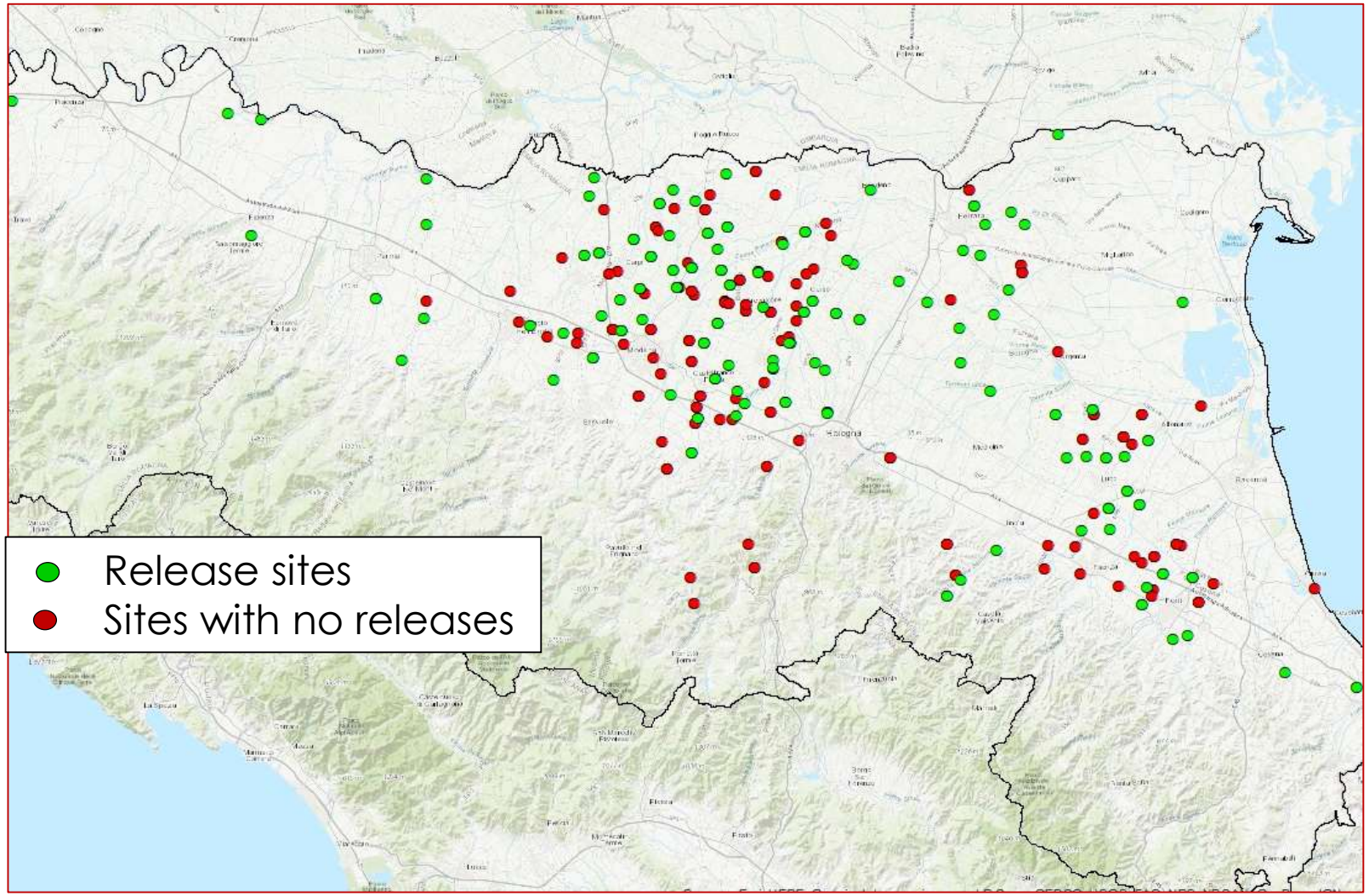
Hatched (nymphs emerged)

Unhatched

Parasitised

Predated

Sites sampled in 2020-2022



- ✓ Only sites where at least 7 BMSB egg masses had been collected were considered for data analysis

  2020: 71 sites (30 with *T. japonicus* releases)

  2021: 68 sites (36 with *T. japonicus* releases)

  2022: 58 sites (32 with *T. japonicus* releases)

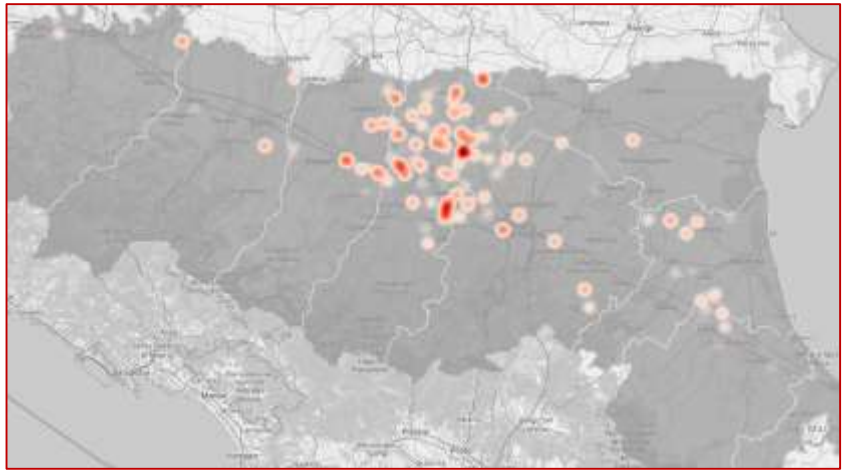
ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

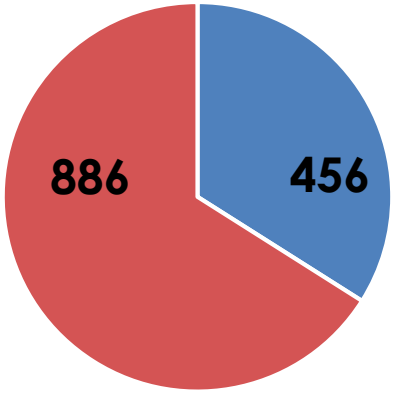
RESULTS

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

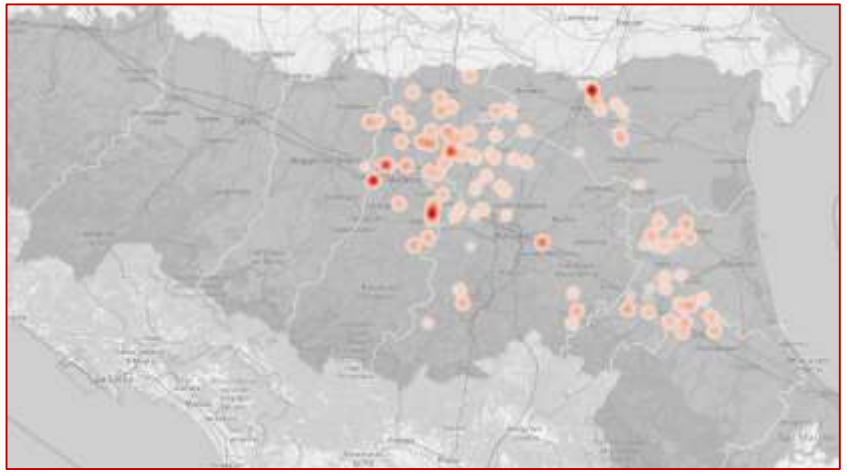
Egg masses of *Halyomorpha halys* collected each year

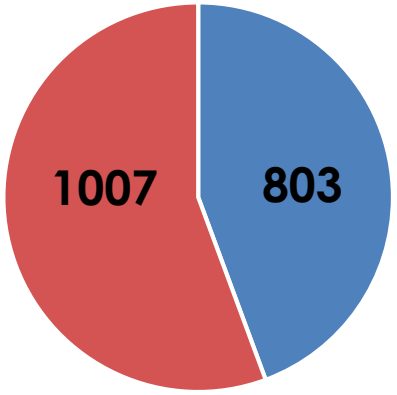
2020
1342 egg masses
35179 eggs



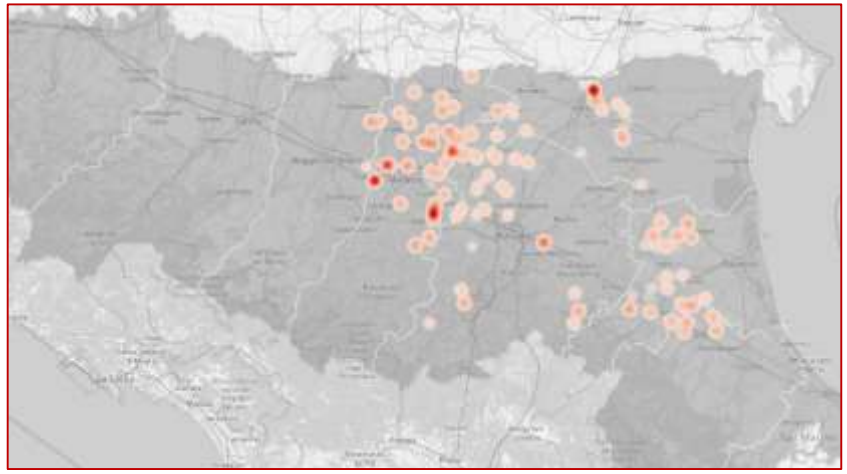


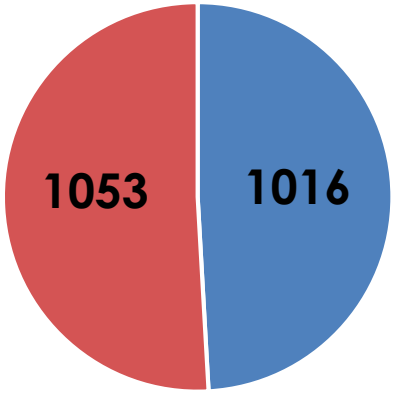
2021
1810 egg masses
47340 eggs





2022
2069 egg masses
54007 eggs



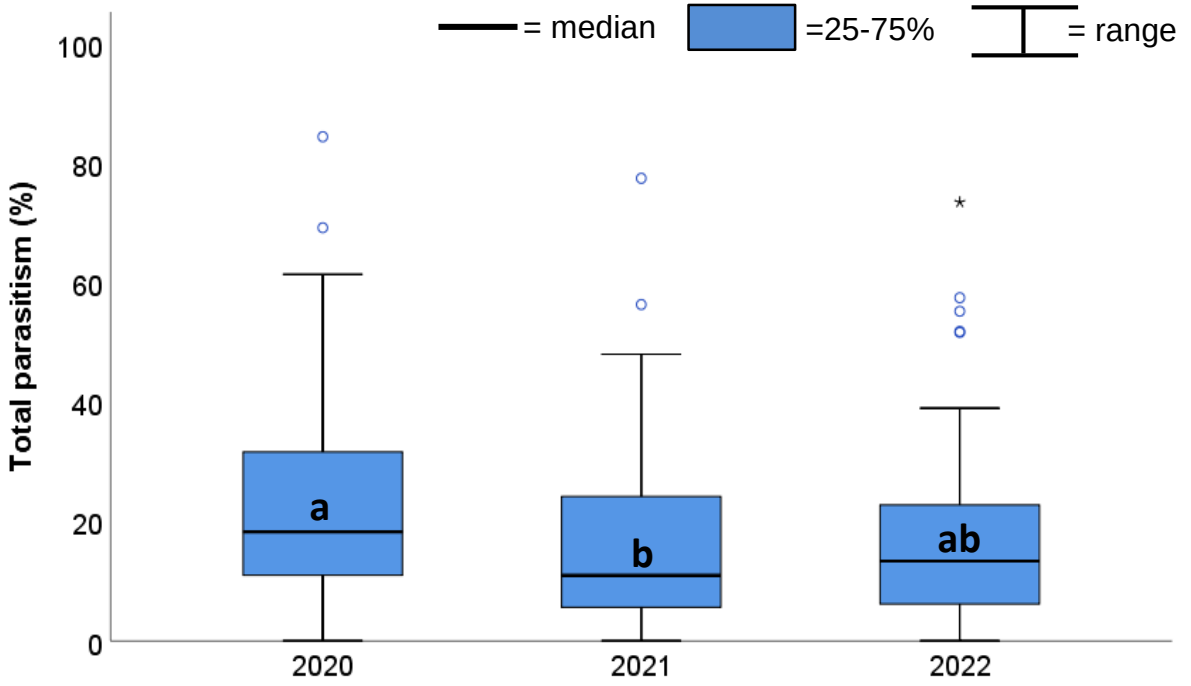


= sites with *T. japonicus* release = sites without releases

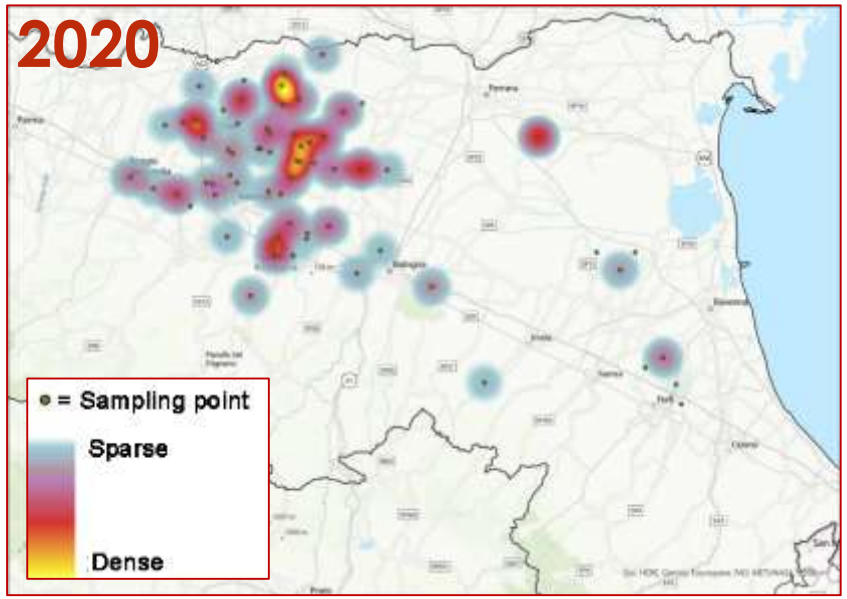
ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

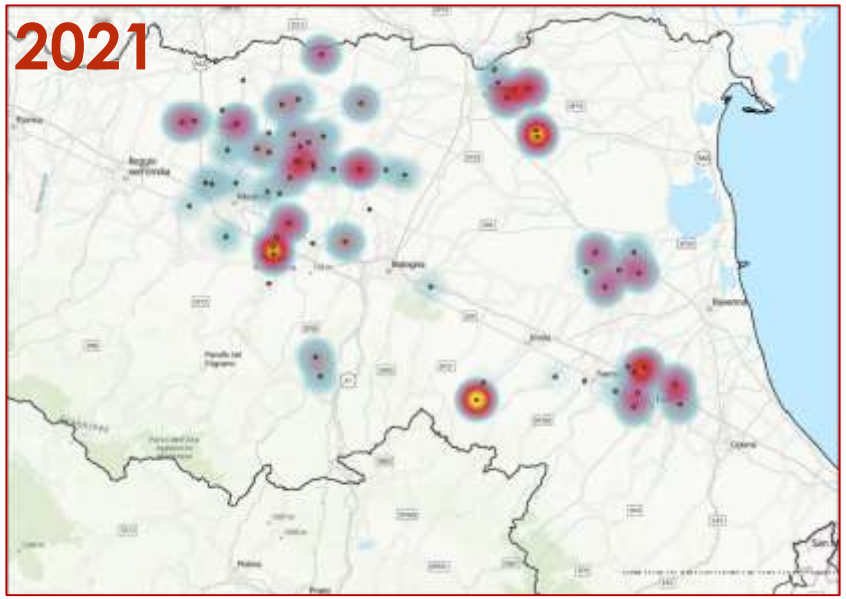
Total parasitism by year

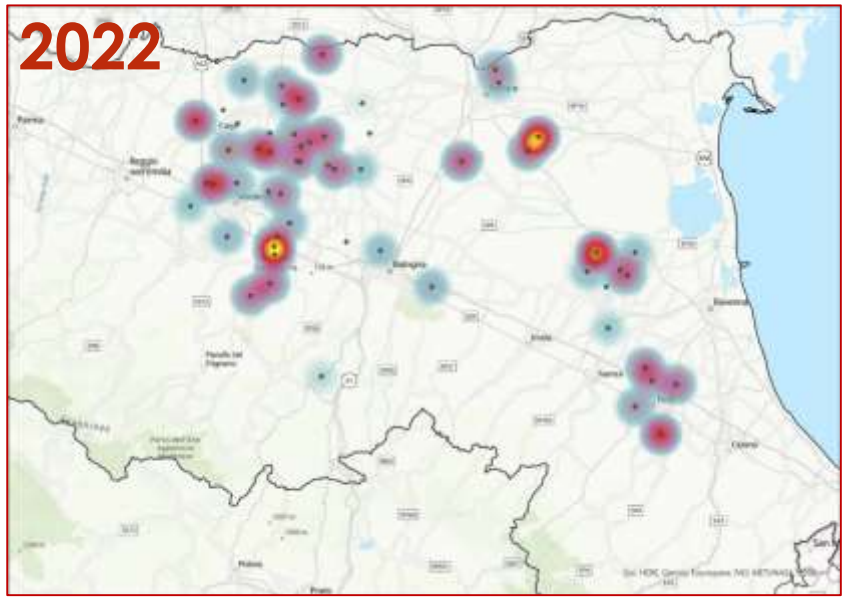
- ✓ **23.9%** in **2020**
- ✓ **14.1%** in **2021**
- ✓ **16.0%** in **2022**



Median tests followed by multiple comparisons with Bonferroni adjustment (*P*<0.05)



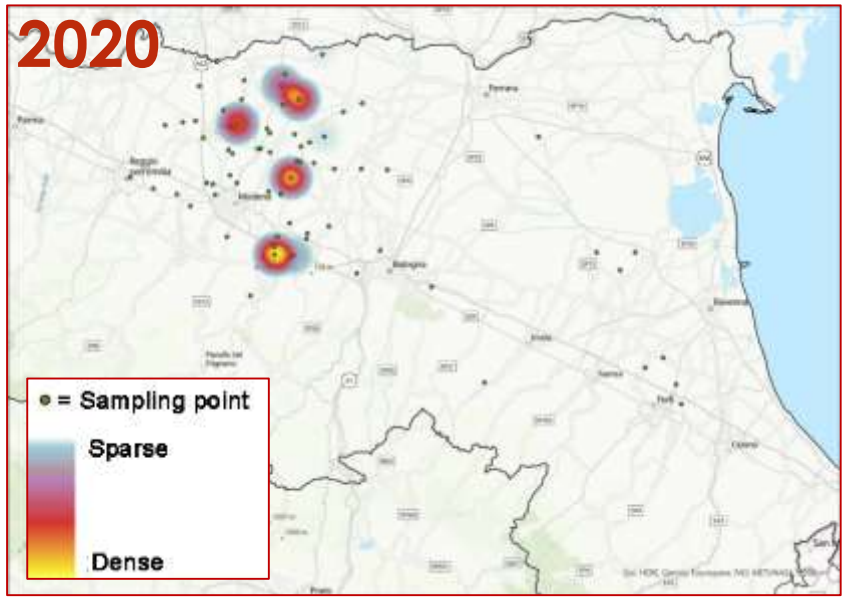


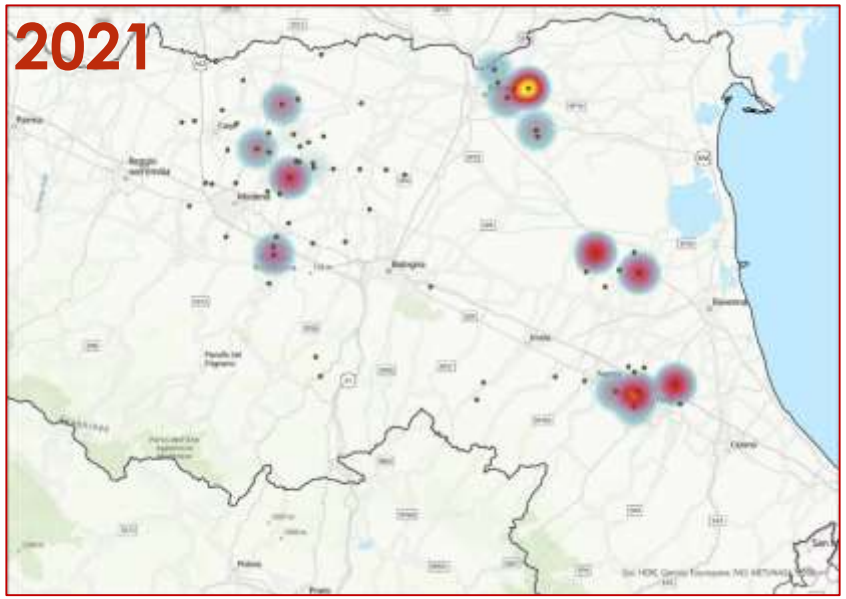


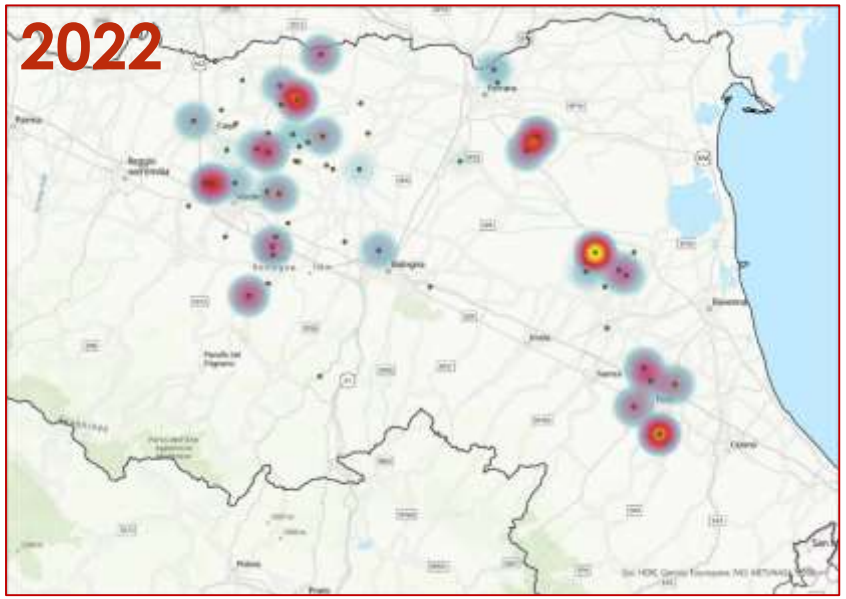
Trissolcus japonicus by year

- ✓ **2020** in **14%** of the sites (10 out of 71):
  - 6 (out of 30) in the release sites
  - 4 (out of 41) in sites without releases
- ✓ **2021** in **25%** of the sites (17 out of 68):
  - 11 (out of 36) of the sites with at least one release
  - 6 (out of 32) in sites without any releases
- ✓ **2022** in **57%** of the sites (33 out of 58):
  - 18 (out of 32) of the sites with at least one release
  - 15 (out of 26) in sites without any releases

Median tests followed by multiple comparisons with Bonferroni adjustment (*P*<0.05)



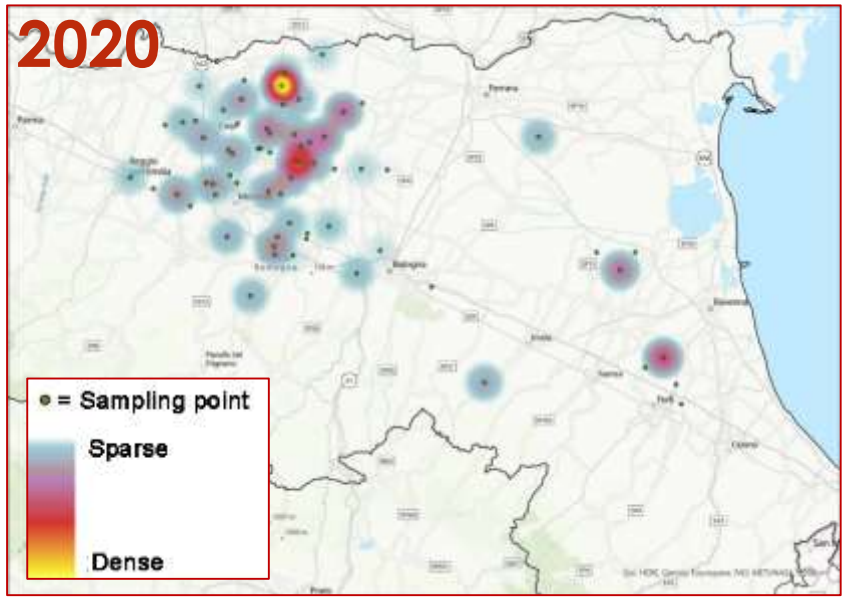


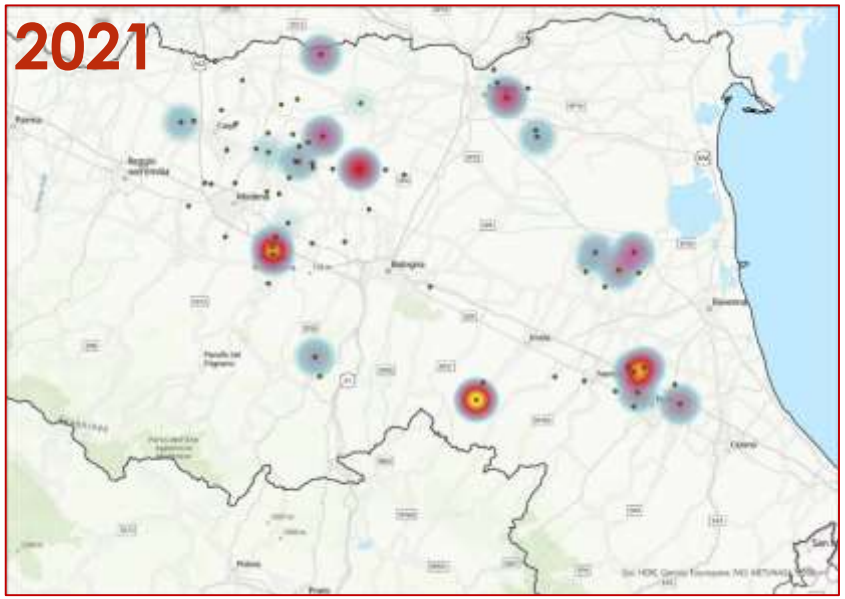


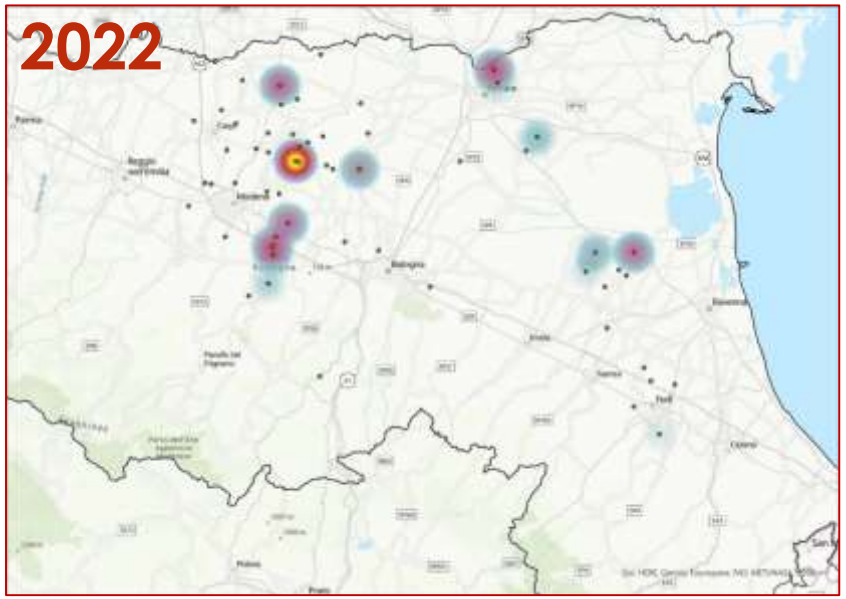
Trissolcus mitsukurii across years

- ✓ **68%** of the sites (48 out of 71) in **2020**
- ✓ **37%** of the sites (25 out of 68) in **2021**
- ✓ **28%** of the sites (16 out of 58) in **2022**

Median tests followed by multiple comparisons with Bonferroni adjustment (*P*<0.05)



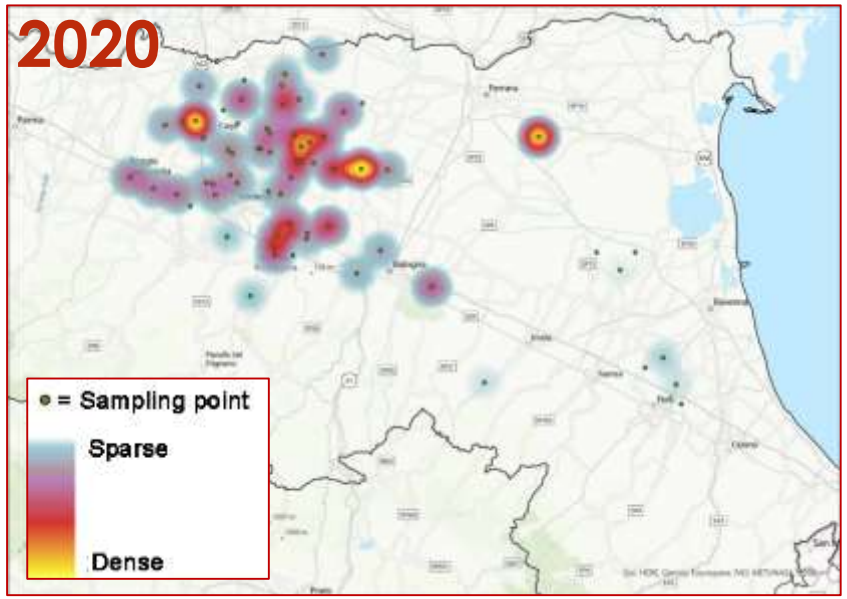


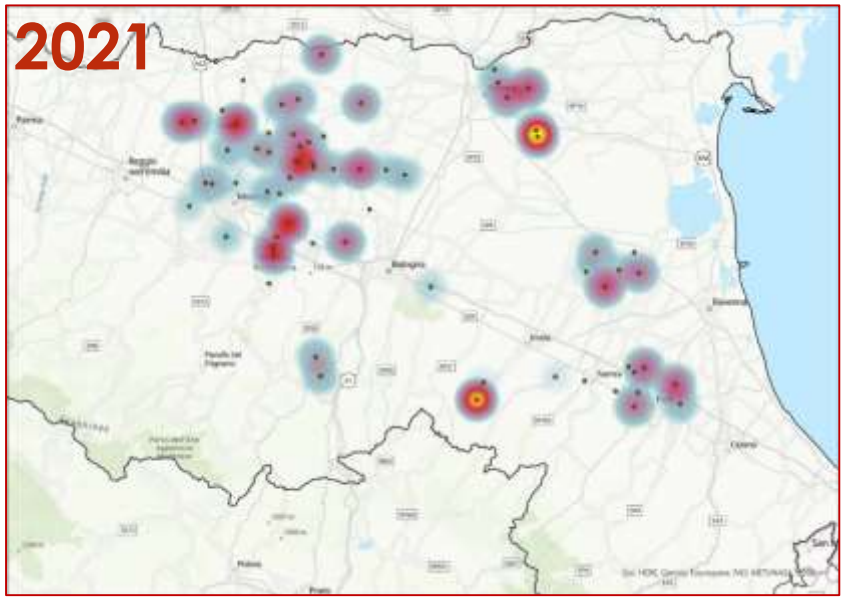


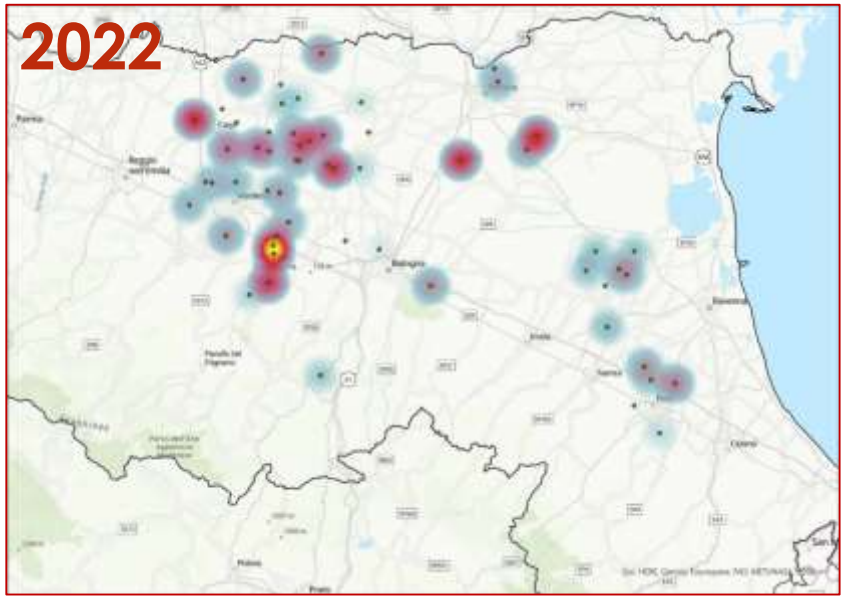
Anastatus bifasciatus across years

- ✓ **84%** of the sites (60 out of 71) in **2020**
- ✓ **81%** of the sites (55 out of 68) in **2021**
- ✓ **88%** of the sites (51 out of 58) in **2022**

Median tests followed by multiple comparisons with Bonferroni adjustment (*P*<0.05)







Parasitoids emerged from eggs of non-target stink bug species

Stink bug species	Egg masses	Total eggs	*Anastatus bifasciatus*	Holes by Eupelmidae	*Trissolcus japonicus*	*Trissolcus mitsukurii*	*Trissolcus basalis*	*Trissolcus spp*	Holes by Scelionidae	*Acroclisoides sinicus*	Holes by Pteromalidae	*Ooencyrtus telenomicida*	N.D.
Nezara viridula	326	28704	640 (2.2)	659 (2.3)	**2 (<0.1)**		58 (0.2)		386 (1.3)	28 (0.1)	7 (<0.1)		284 (1.0)
Dolycoris baccarum	107	1801	46 (2.6)	12 (0.7)		5 (0.3)		8 (0.4)	80 (4.4)	1 (0.1)	8 (0.4)	9 (0.5)	117 (6.5)
Rhaphigaster nebulosa	60	821	23 (2.8)	38 (4.6)		15 (1.8)			73 (8.9)		14 (1.7)		66 (8.0)
Pentatomidae	18	457	5 (1.1)		**3 (<0.1)**				16 (3.5)				186 (40.7)
Graphosoma italicum	23	331	1 (0.3)	10 (3.0)			13 (3.9)		28 (8.5)				23 (6.9)
Peribalus strictus	24	311	1 (0.3)		**13 (4.2)**				34 (10.9)				13 (4.2)
***Acrosternum* spp.**	9	148	22 (14.9)	1 (0.7)									
Palomena prasina	6	139	9 (6.5)										
***Carpocoris* spp.**	8	112	26 (23.2)	6 (5.4)									
Arma custos	2	37											
***Picromerus* spp.**	1	22											
Coreidae	36	218	41 (18.8)	3 (1.4)									34 (15.6)
Gonocerus acuteangulatus	7	56	8 (14.3)	7 (12.5)									
Reduviidae	3	76											

Percentages of parasitsm are reported in brackets

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

CONCLUSIONS

- ✓ The total parasitism rate fluctuated from 24% in 2020 to 14% in 2021.
- ✓ Natural mortality, predation and parasitoids suppressed ≈45% of BMSB eggs.
- ✓ Over the three-year sampling period, ***Anastatus bifasciatus*** was the most abundant and widespread species in Emilia-Romagna.
- ✓ The abundance and diffusion of ***Trissolcus mitsukurii*** has been gradually declining.
- ✓ The abundance of ***Trissolcus japonicus*** increased over the years and the number of sites where it was found increased as well.
- ✓ In 2021 and 2022, ***Trissolcus japonicus*** was found at sites in which it was released only in 2020 and in other sites where it had never been released. The individuals released appear to have settled and overwintered.
- ✓ Both exotic species showed negligible impact of on non-target bugs in the sampling areas and in the sampling period.
- ✓ The releases appear to have achieved the goal of contributing to the spread of *Trissolcus japonicus* in Emilia-Romagna.

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

Thank you all for listening

A. Masetti[1], E. Costi, F. Lami, A. Zaniboni, M. Ceccarelli, D. Torreggiani, G. Vaccari, S. Caruso, M. Preti, L. Fagioli, F. Manucci, R. Ferrari, M. Bariselli, M. G. Tommasini, G. Burgio, L. Maistrello

[1] Department of Agricultural and Food Science, University of Bologna
Viale G. Fanin, 42 - 40127 Bologna, Italy

e-mail: antonio.masetti@unibo.it
www.distal.unibo.it

Programma di Sviluppo Rurale dell'Emilia-Romagna 2014-2020

Study funded by Emilia-Romagna Region region within the Rural Development Plan 2014-2020
Op. 16.1.01 – GO EIP-Agri - FA 4B

www.unibo.it