MONITORING INVASIVE AEDES

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COST Action CA 17108
Training Course
Harmonising Aedes invasive mosquito (AIM) surveillance across Europe
Akrotiri Environmental Education Centre, Akrotiri, Cyprus
13 - 17th January 2020

Aedes albopictus

Aedes japonicus

Aedes koreicus

Aedes aegypti

Monitoring or Surveillance ?

ALBO MANAGEMENT PLAN COMPONENTS

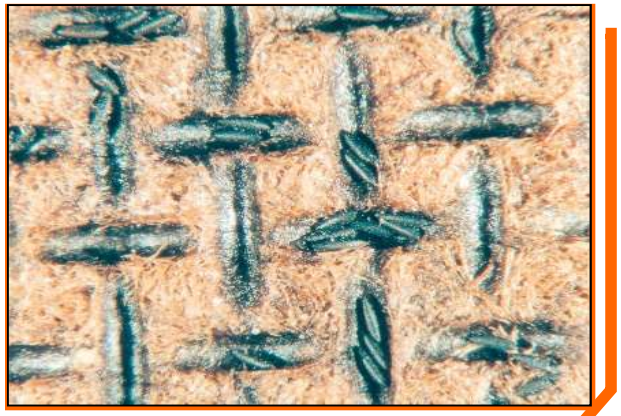
- 1. Public health risk assessment
- 2. Monitoring by ovitraps-Field management
- 3. Standard control measures in public and private areas
- 4. Community participation
- 5. Door-to-door control measures in private areas
- 6. Emergence control measures in case of DEN, CHIK & ZIKA imported cases detection
- 7. Quality control to check the efficacy of larvicide treatments in public road drains
- 8. Resistance prevention

THE NEED TO IMPLEMENT EASY AND RELIABLE METHODS FOR VECTOR POPULATION DENSITY ESTIMATION

- to see the spatial / geographic distribution
- to follow the vector density along the season and in the long term
- to better understand the impact of vector control measures
- to evaluate epidemic risk levels

METHODS & TOOLS

- House Index
- Container Index
- Breteau Index
- Number of pupae/premise (PG)
- Number of pupae/Ha (PHa)
- **Ovitrap data**
- Gravid trap
- Sticky trap
- BG-trap
- Human Landing Collection (HLC)



Ovitrap for weekly inspection:

- 500 ml capacity
- 300 ml water
- masonite strip 2.5 cm wide

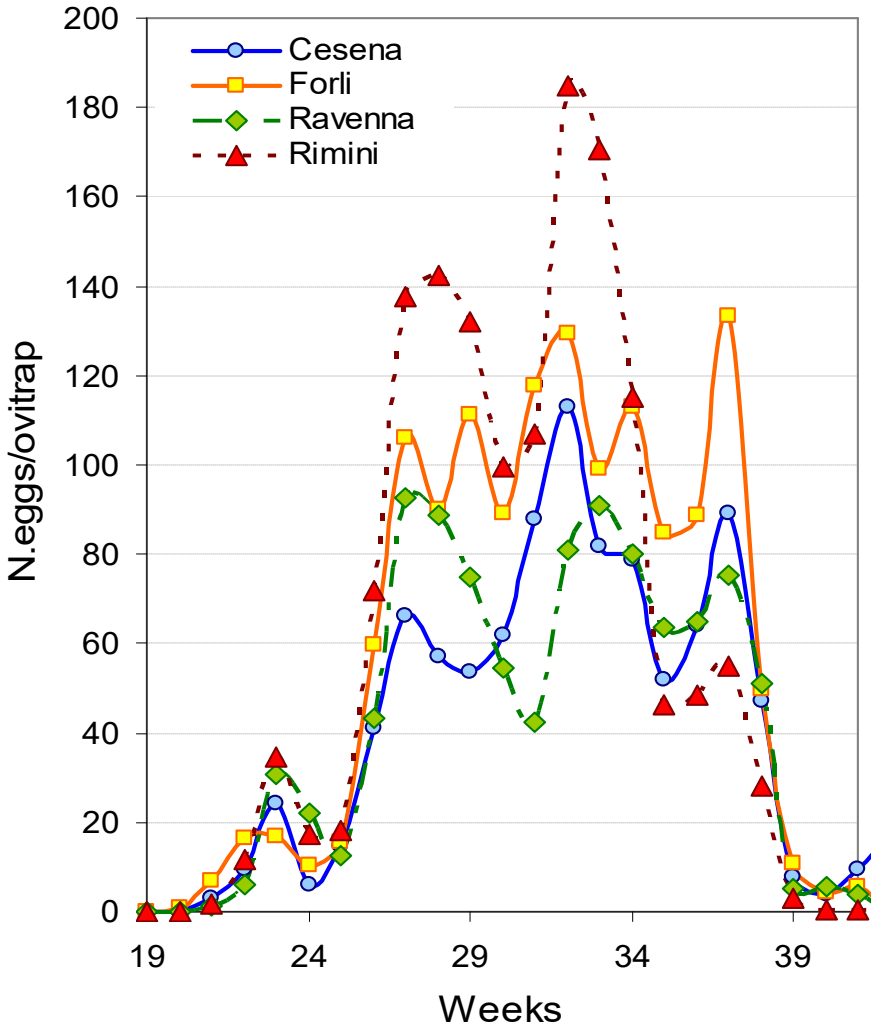
Ovitrap for beweekly inspection:

- 1400 ml capacity
- 800 ml water+Bti
- masonite strip 2.5 cm wide

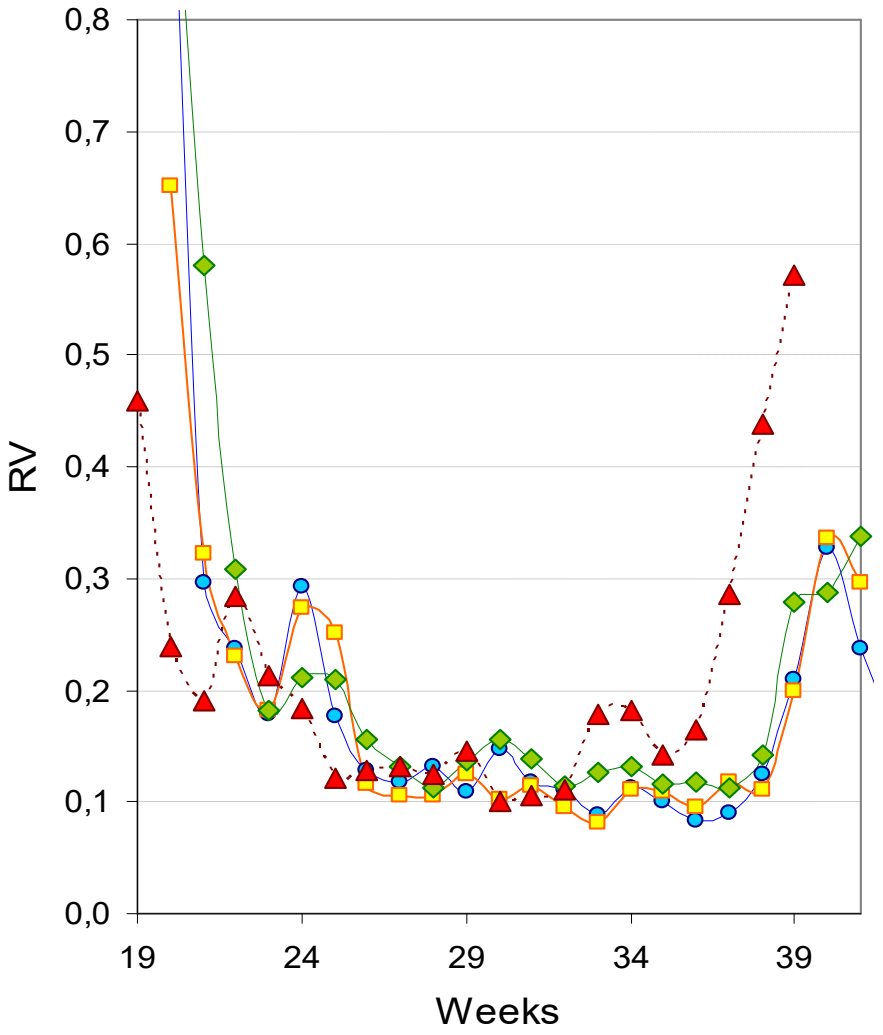
Ovitraps data

The number of ovitraps to be placed may be calculated by means of the Taylor's equation. setting the precision's coefficient at D=0.2-0.3 (Southwood and Henderson 2000)

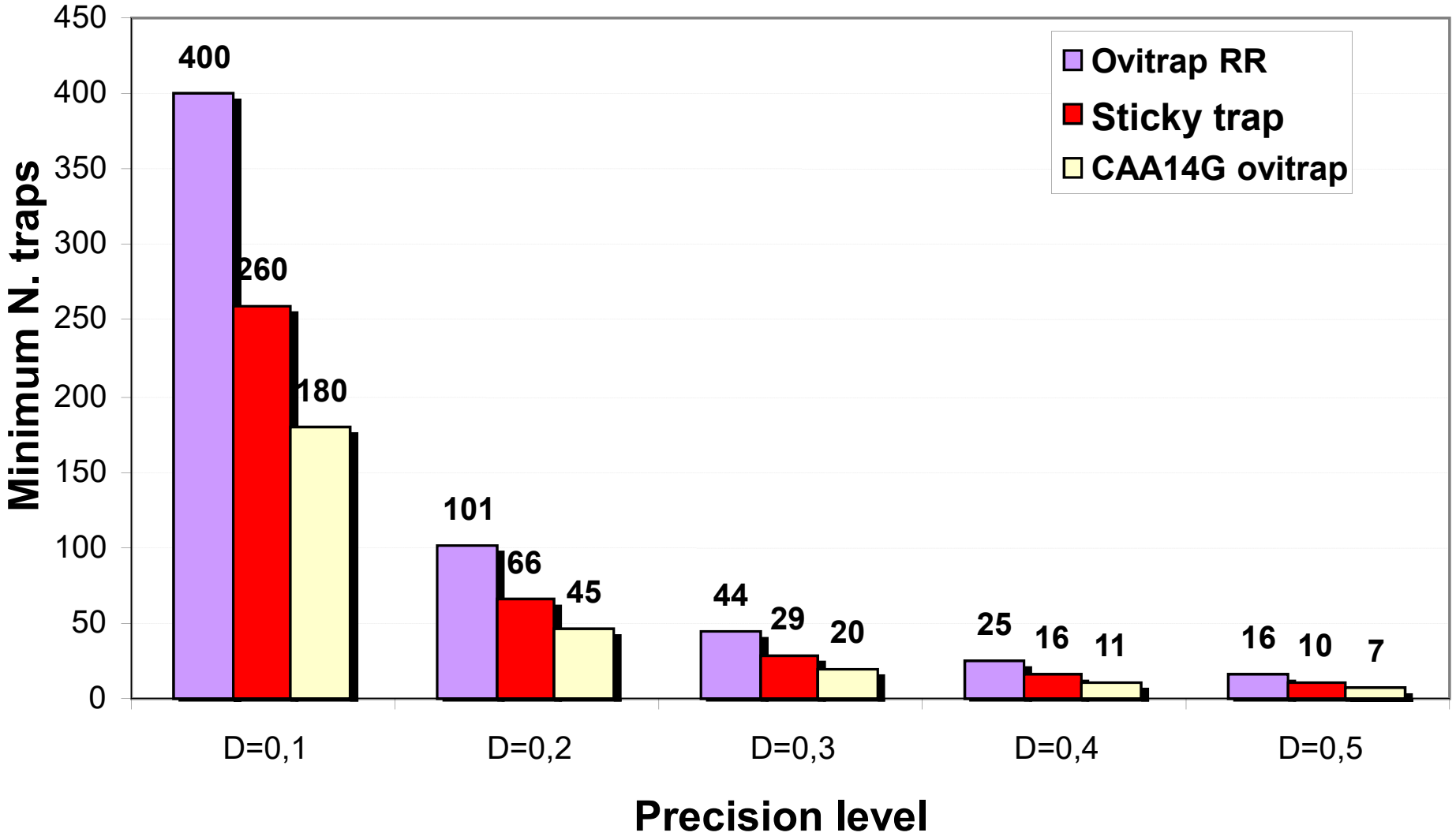
Mean weekly number of N. eggs/ovitrap



Relative Variation Coefficient in the study period



Sample dimension by Taylor's power law



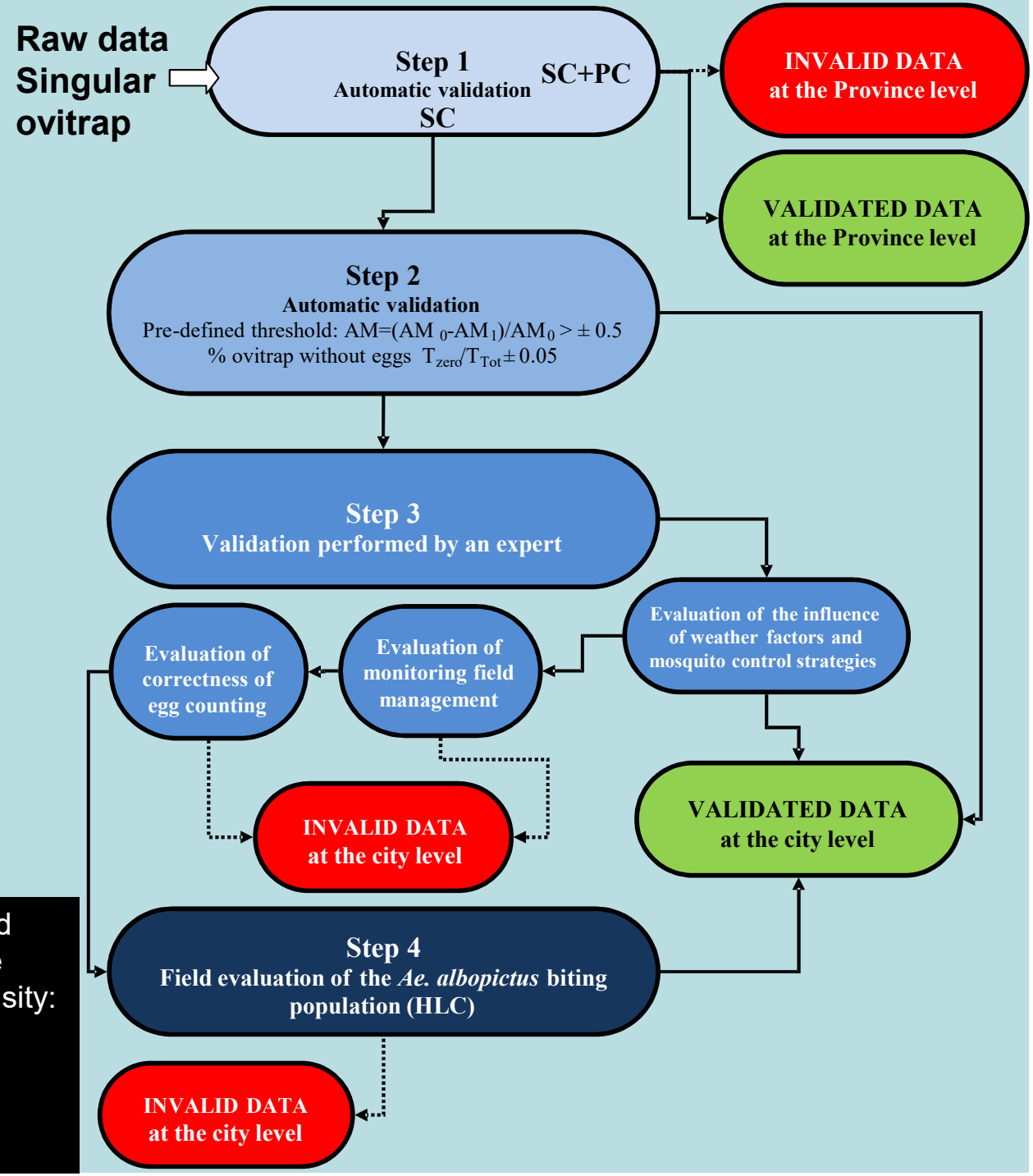
Quantitative monitoring of *Aedes albopictus*

Emilia-Romagna (4.4 ML inhabitants)

http://www.zanzaratigreonline.it

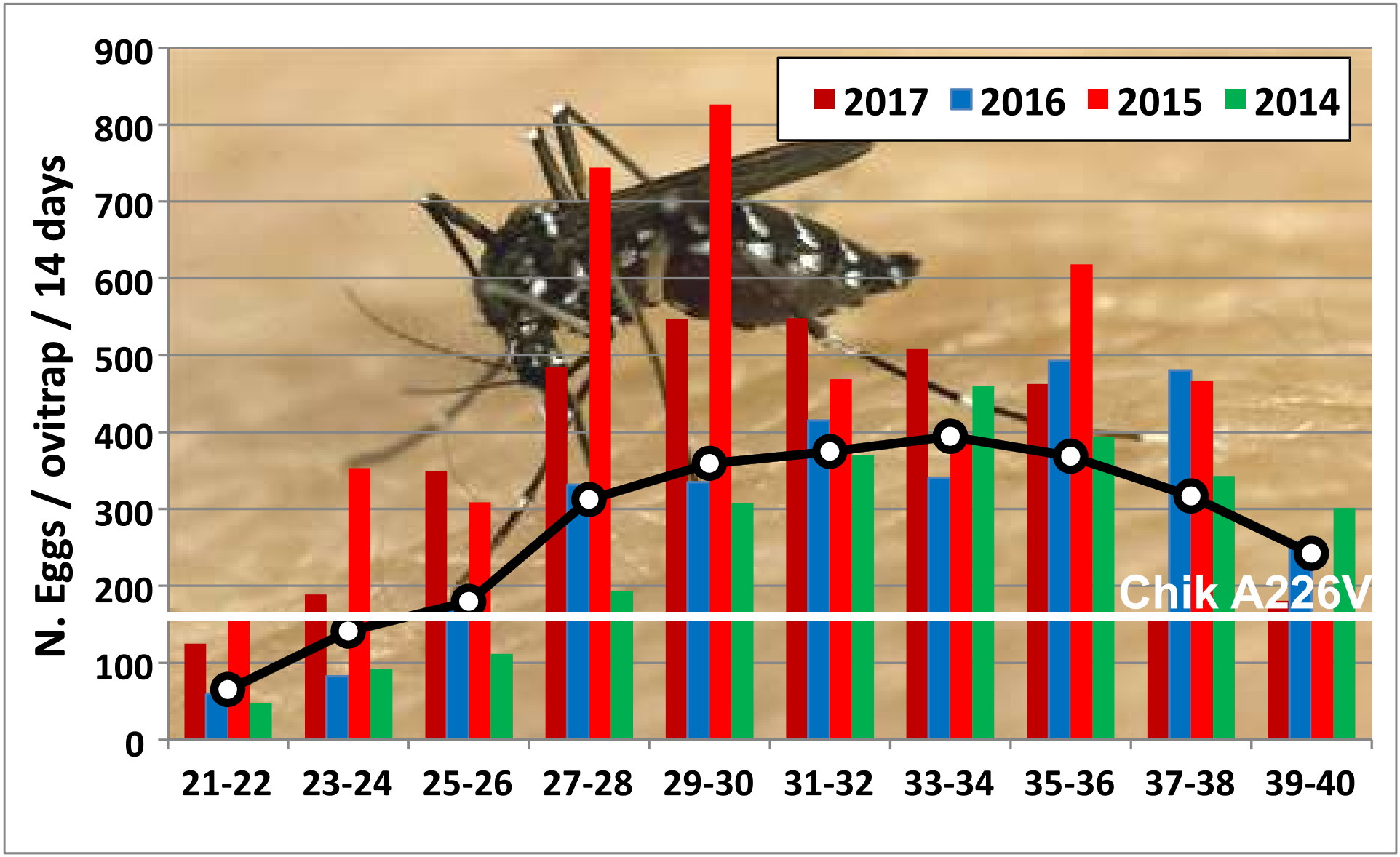
	N. ovit.	N. Municip.
2008	2744	242
2009	2606	245
2010	2777	256
2011	2783	256
2012	2581	253
2013	2706	263
2014	2649	257
2015	2640	256
2016	2642	254
2017	755	10
2018	755	10
2019	755	10

QUALITY CONTROL IN AEDES ALBOPICTUS MONITORING



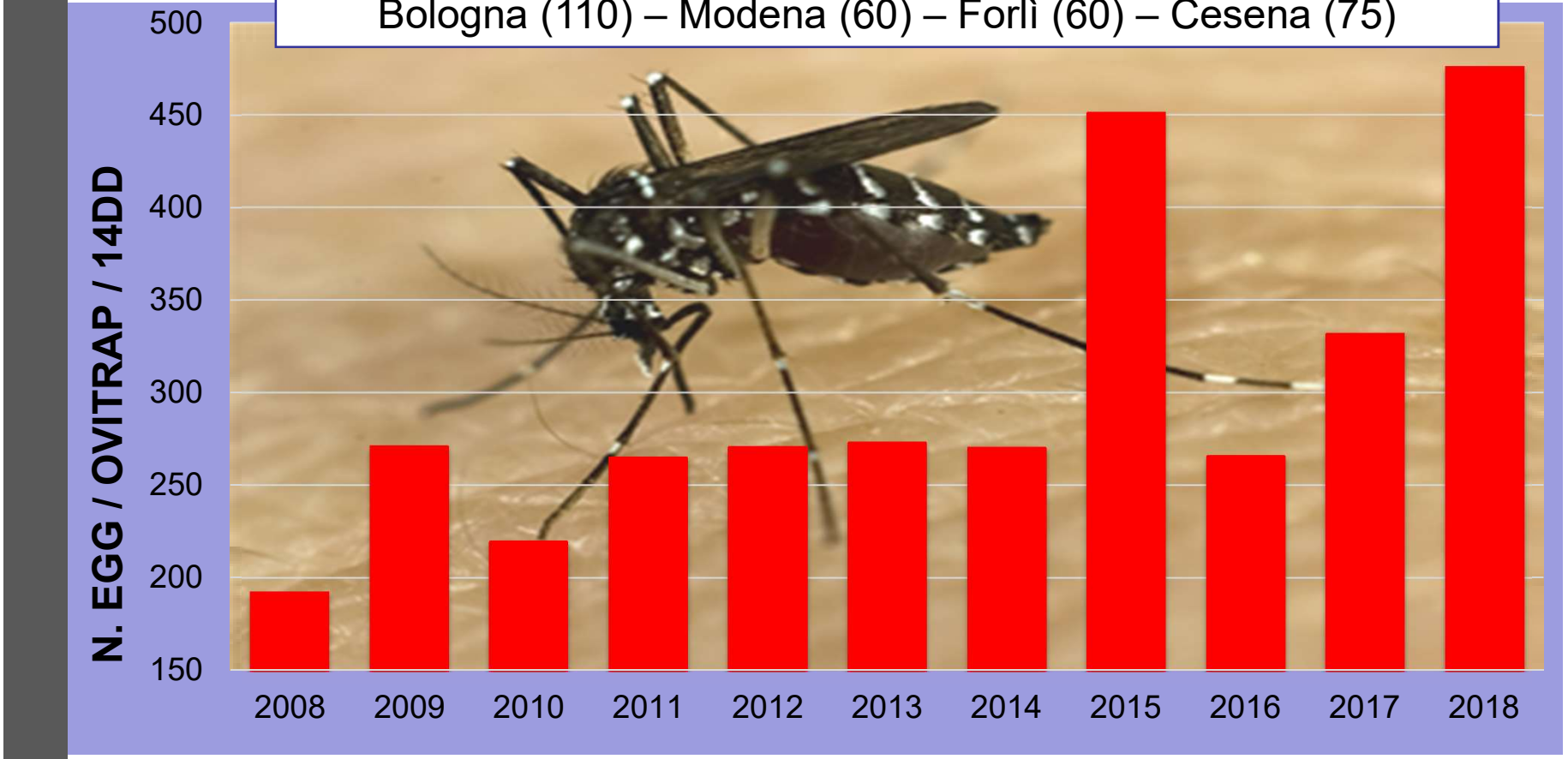
Carrieri et al. (2017) Quality control and data validation procedure in large-scale quantitative monitoring of mosquito density: the case of Aedes albopictus in Emilia-Romagna region. Italy. Pathogens and Global Health. 111:2. 83-90. DOI: 10.1080/20477724.2017.1292992

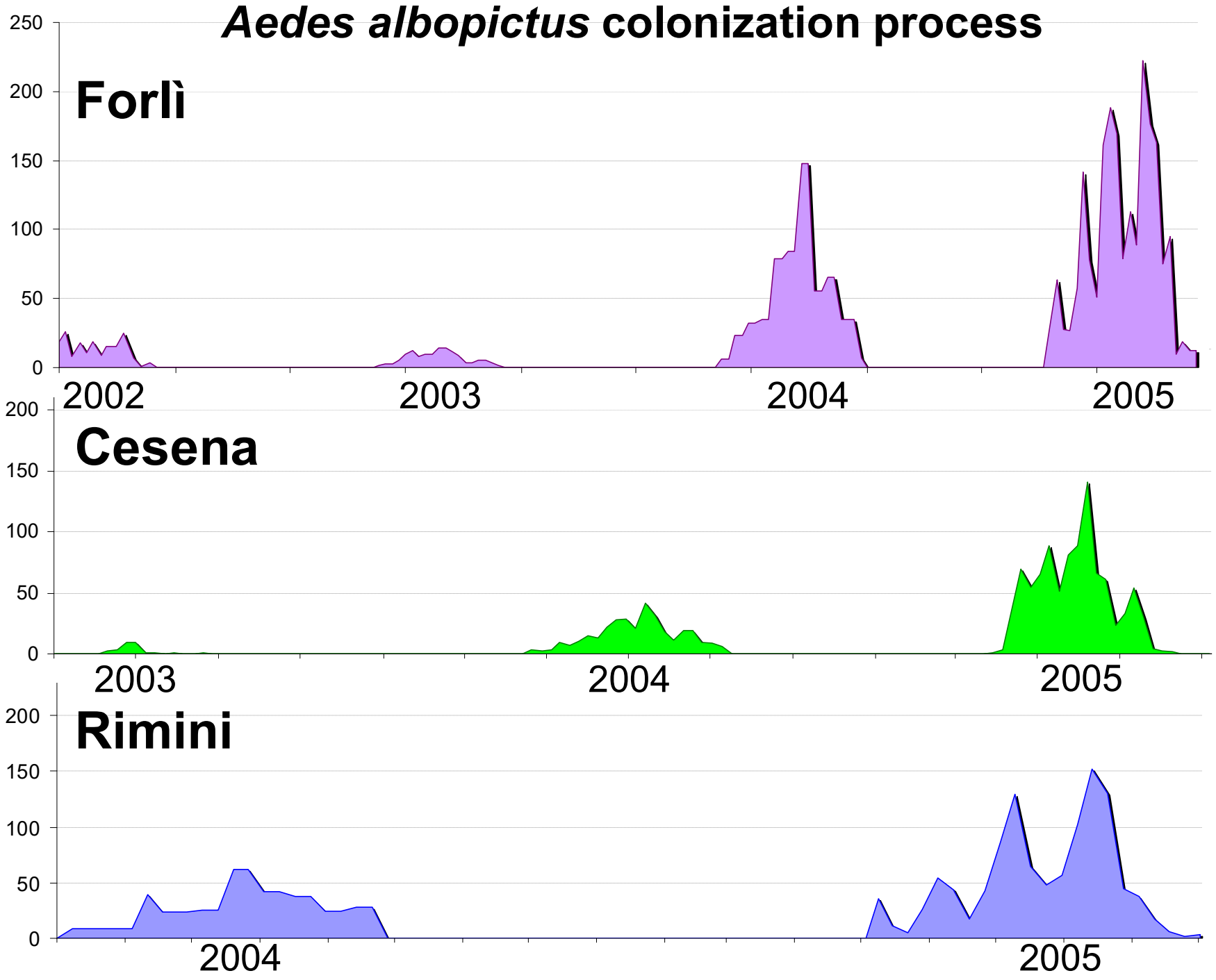
Aedes albopictus monitoring E-R



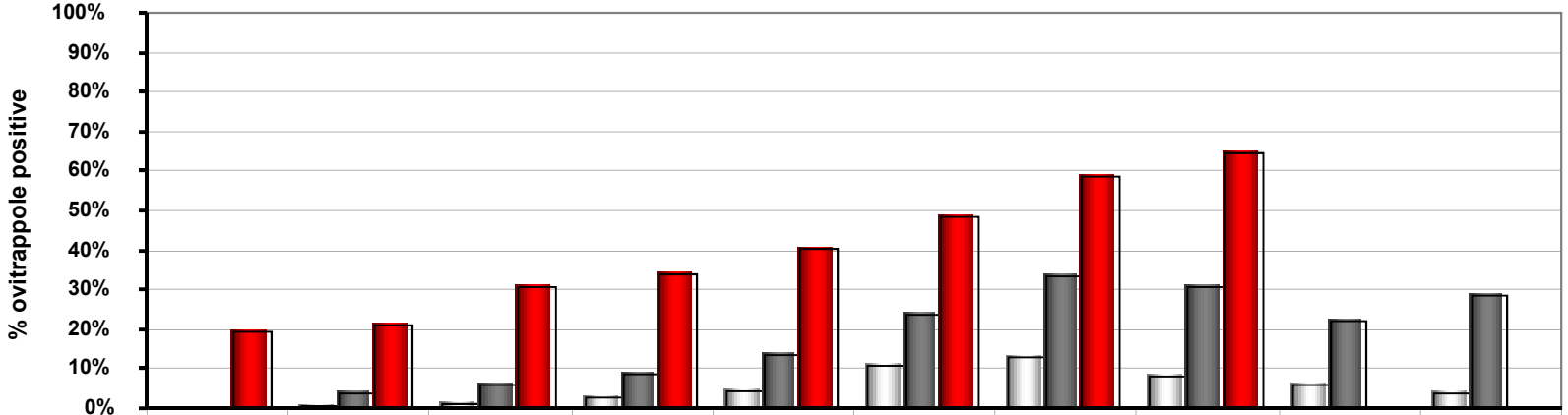
Aedes albopictus in Emilia-Romagna

Bologna (110) – Modena (60) – Forlì (60) – Cesena (75)

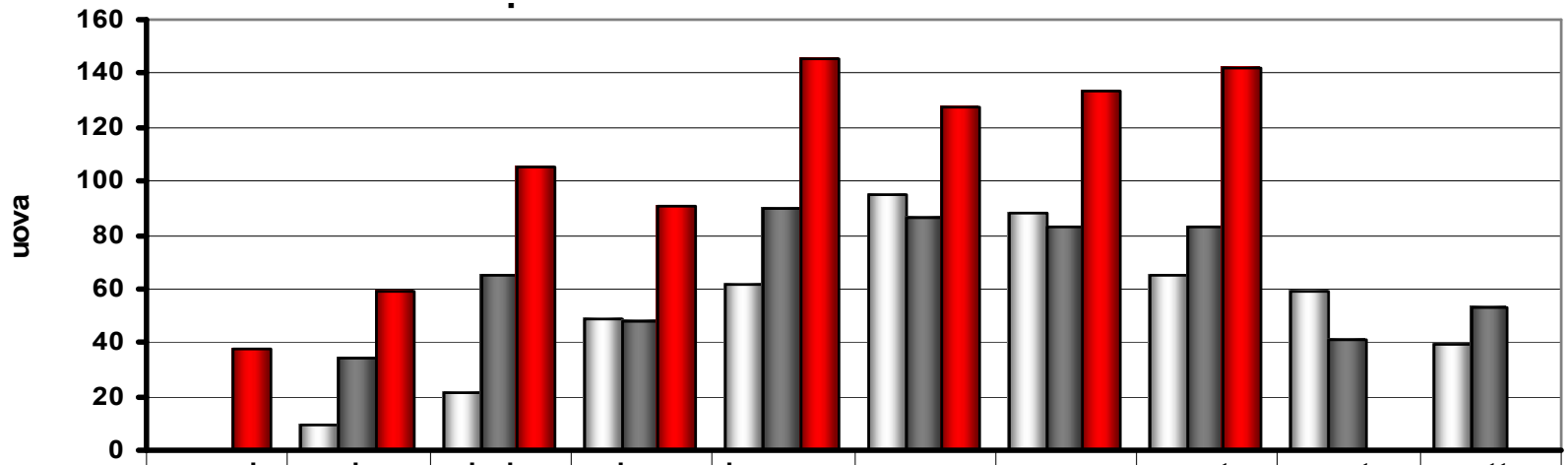



Aedes albopictus colonization process
Forlì
250
200
150
100
50
0
2002
2003
2004
2005
Cesena
200
150
100
50
0
2003
2004
2005
Rimini
200
150
100
50
0
2004
2005

Aedes albopictus colonization dynamic in Milan

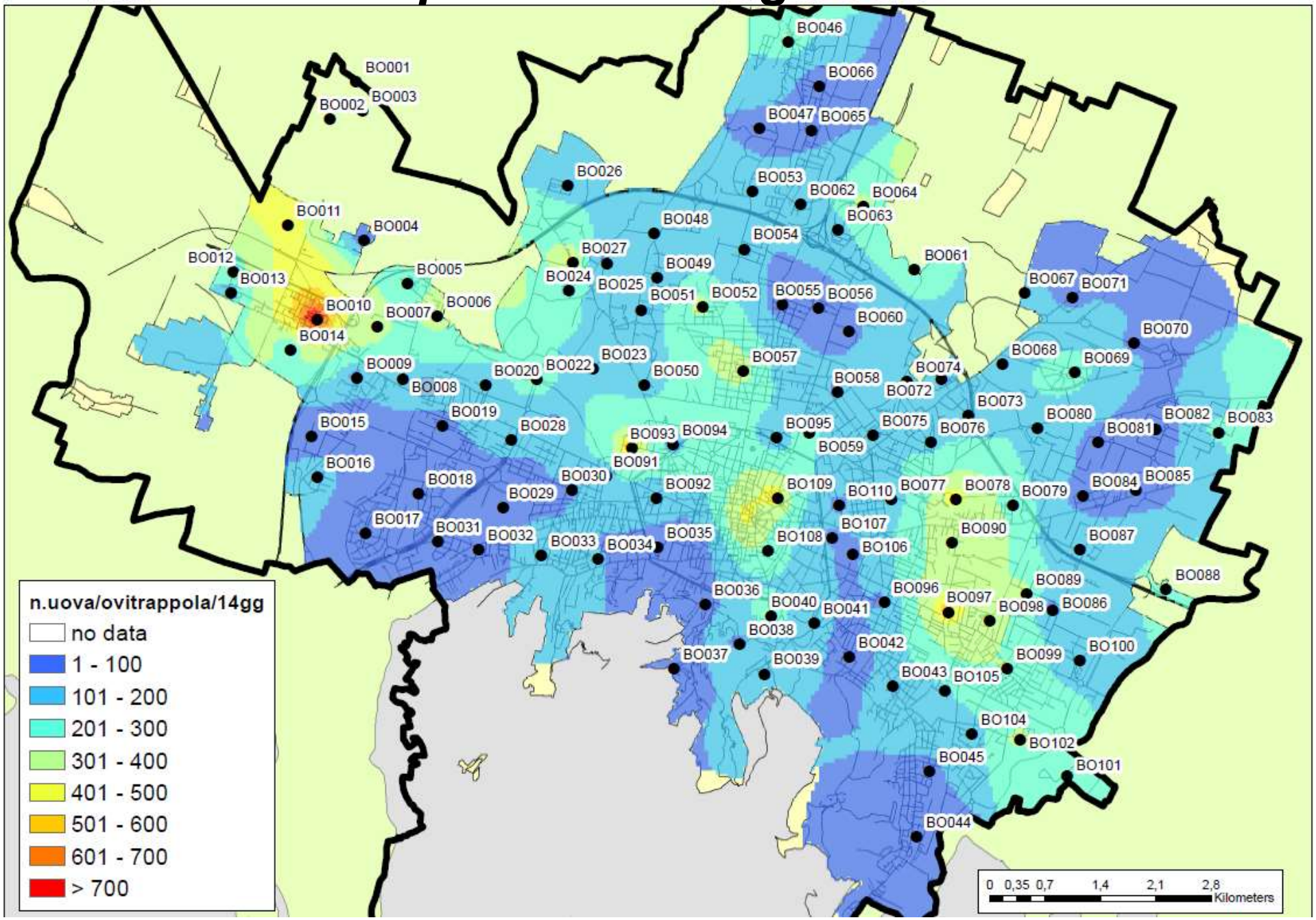


	mag-giu	giu	giu-lug	lug	lug-ago	ago	ago	set	set	ott
2003		0,4%	1,1%	2,7%	4,4%	10,5%	12,9%	7,9%	6,0%	4,0%
2004		3,6%	6,0%	8,5%	13,6%	23,8%	33,5%	30,9%	22,3%	28,4%
2005	19,6%	20,8%	30,7%	34,0%	40,1%	48,2%	58,7%	64,7%		

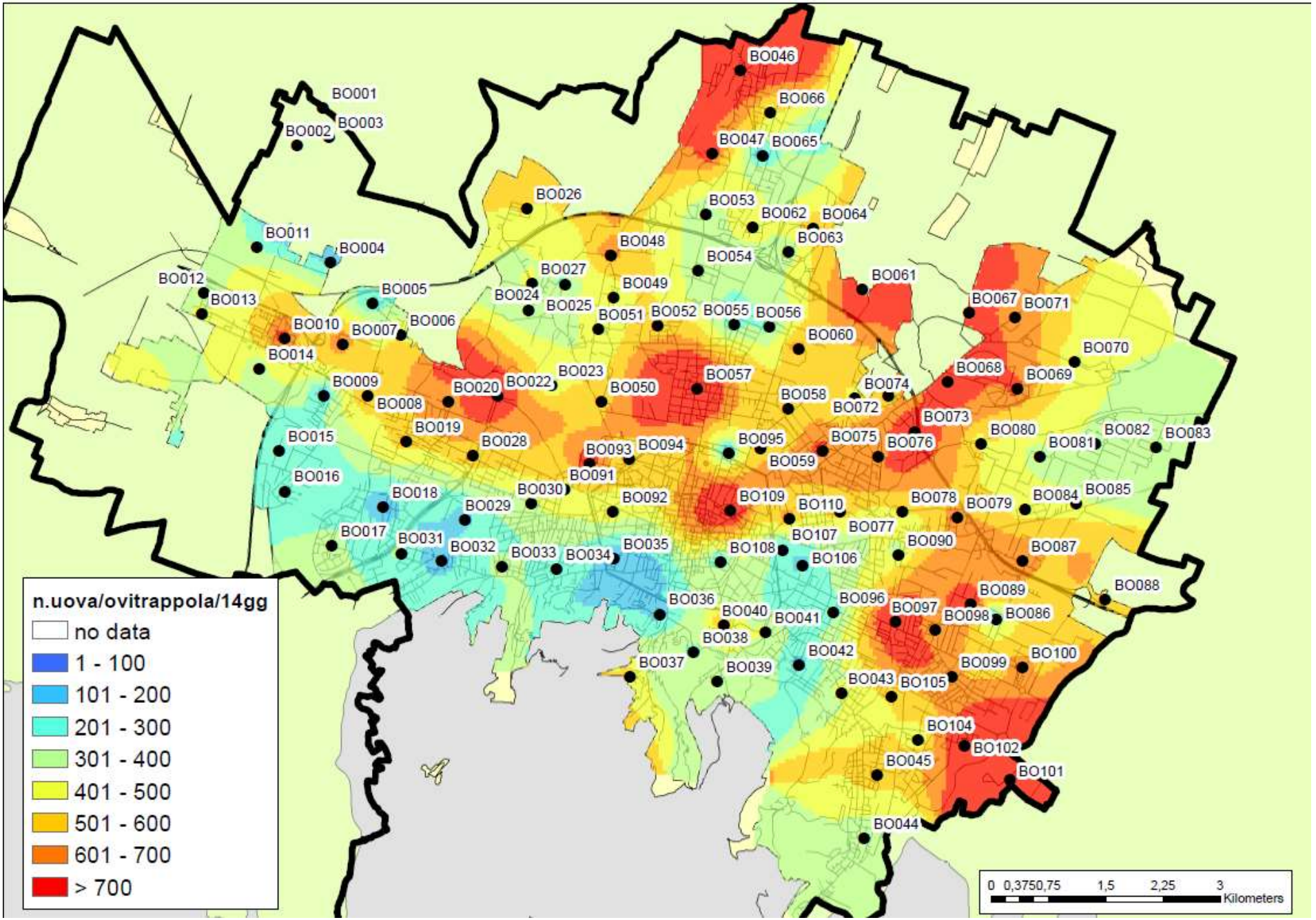


	mag-giu	giu	giu-lug	lug	lug-ago	ago	ago	set	set	ott
anno 2003		9,0	21,0	48,8	61,2	95,0	88,3	64,9	59,1	39,0
anno 2004		34,5	65,3	48,2	89,8	86,4	83,1	83,4	40,8	53,4
anno 2005	37,7	58,8	105,4	90,7	145,4	127,4	133,5	142,4		

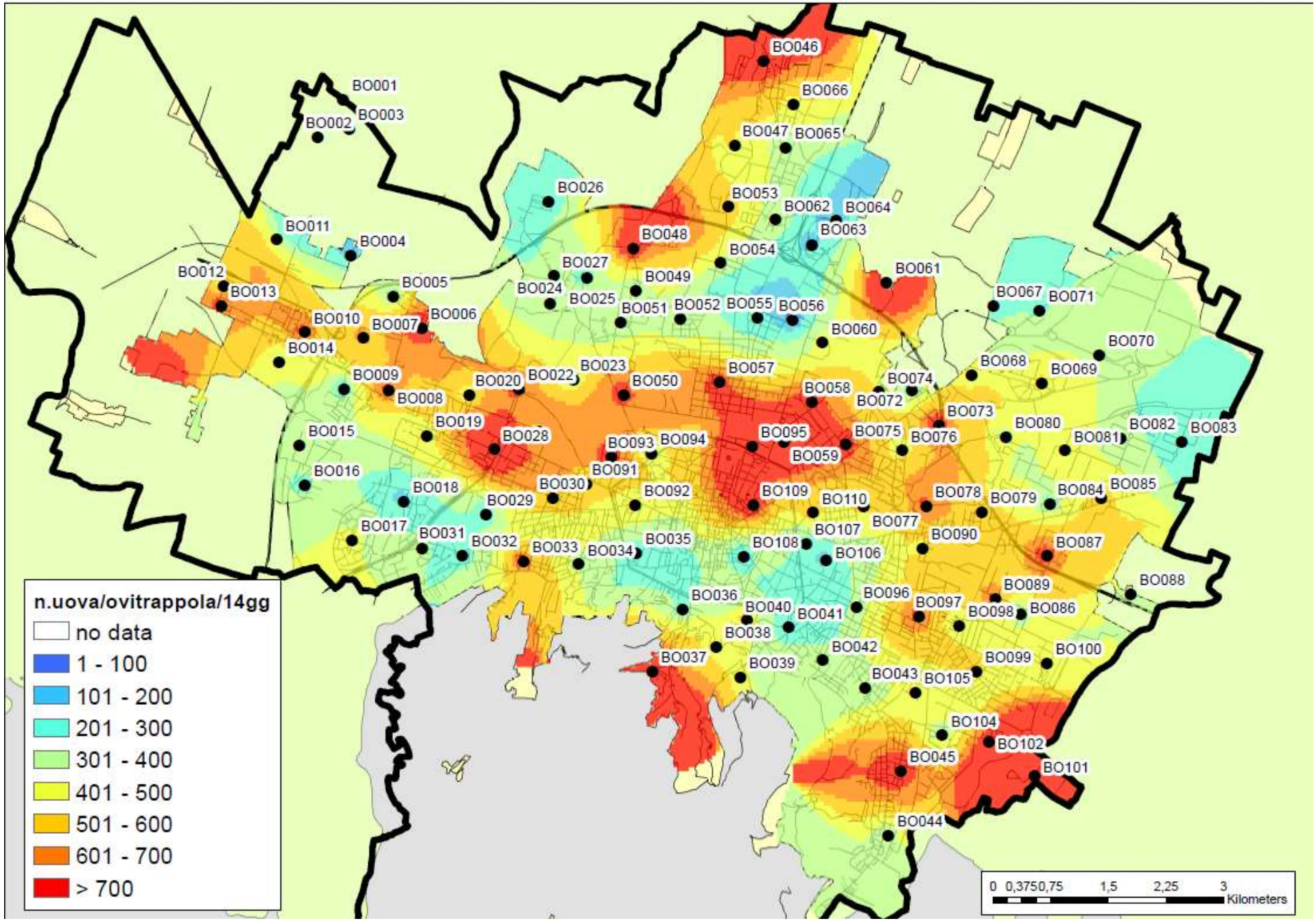
Aedes albopictus in Bologna – June 2019



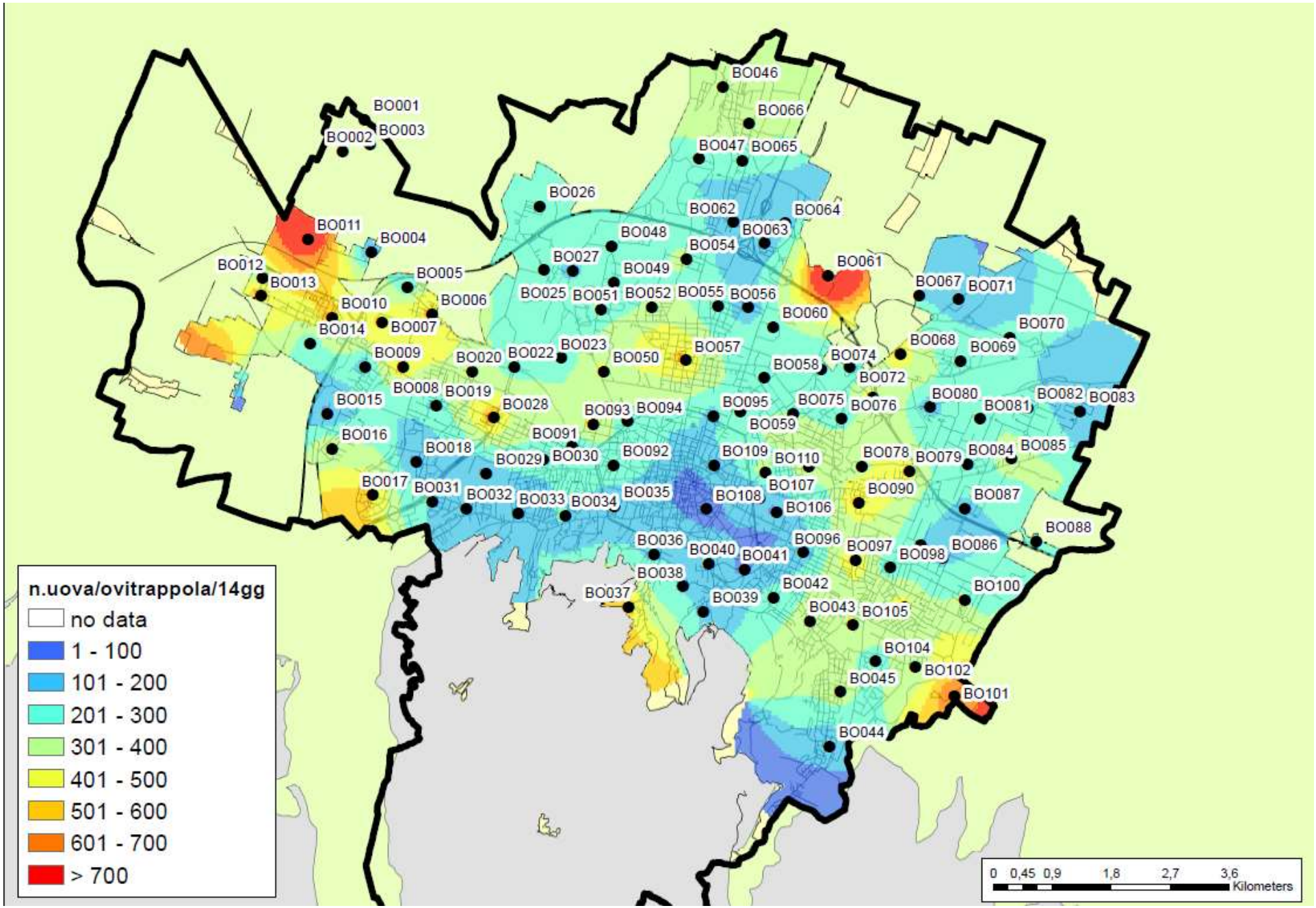
Aedes albopictus in Bologna – July 2019



Aedes albopictus in Bologna – August 2019



Aedes albopictus in Bologna – September 2019



Pearson product moment correlations (R) for the *Stegomya* Indices

	HI	CI	BI	PG	PHa	PP
House Index - HI	----------	0.9196**	0.9621**	0.7795**	-0.3095	0.7710**
Container Index – CI		----------	0.8758**	0.6994*	-0.3970	0.7607**
Breteau Index – BI			----------	0.8855**	-0.2750	0.8005**
Pupae/premise – PG				----------	-0.2106	0.9181**
Pupae/Ha – PHa					----------	-0.3901
Pupae/person – PP						----------

Pearson product moment correlations (R) between *Stegomya* Indices and the mean N. eggs/ovitrap/week collected the week before. the same week. and the week following the inspection.

Population Indexes	Mean number eggs/week/ovitrap		
	Previous week	Inspection week	Week after
HI – House Index	0.0867	-0.1117	-0.3778
CI – Container Index	0.3194	0.0482	-0.4175
BI – Breteau Index	0.0623	-0.1465	-0.4313
PG – Pupae/premise	-0.0289	-0.2553	-0.5118
PHa – Pupae/Ha	0.1703	0.3396	**0.8622****

***p<0.05 and ** p<0.01**

N. bites/day declared by citizens and HLC

Period 2008	Town	Mean number bites/day declared (total N= 2.357)			HLC in 15 min		
		N	Mean ± SD		N	Mean ± SD	
June	Cesena	208	0.37 ± 1.06	a	15	0.73 ± 1.33	ns
	Forlì	225	1.15 ± 2.49	b	15	1.00 ± 1.25	
	Ravenna	192	0.41 ± 1.15	a	15	0.60 ± 0.83	
	Rimini	196	0.23 ± 0.66	a	15	0.53 ± 1.06	
July	Cesena	185	1.48 ± 3.15	ns	15	1.27 ± 0.96	ns
	Forlì	180	1.59 ± 2.69		15	3.80 ± 3.93	
	Ravenna	185	0.73 ± 2.08		15	1.93 ± 2.12	
	Rimini	213	1.11 ± 2.19		15	2.20 ± 2.51	
August	Cesena	189	1.26 ± 2.71	a	15	-	a
	Forlì	189	1.67 ± 2.91	a	15	5.73 ± 4.48	
	Ravenna	173	1.50 ± 3.22	b	15	2.73 ± 2.4	b
	Rimini	222	1.12 ± 3.59	ab	15	-	
All Groups		2357	1.04 ± 2.53		180	2.09 ± 2.69	

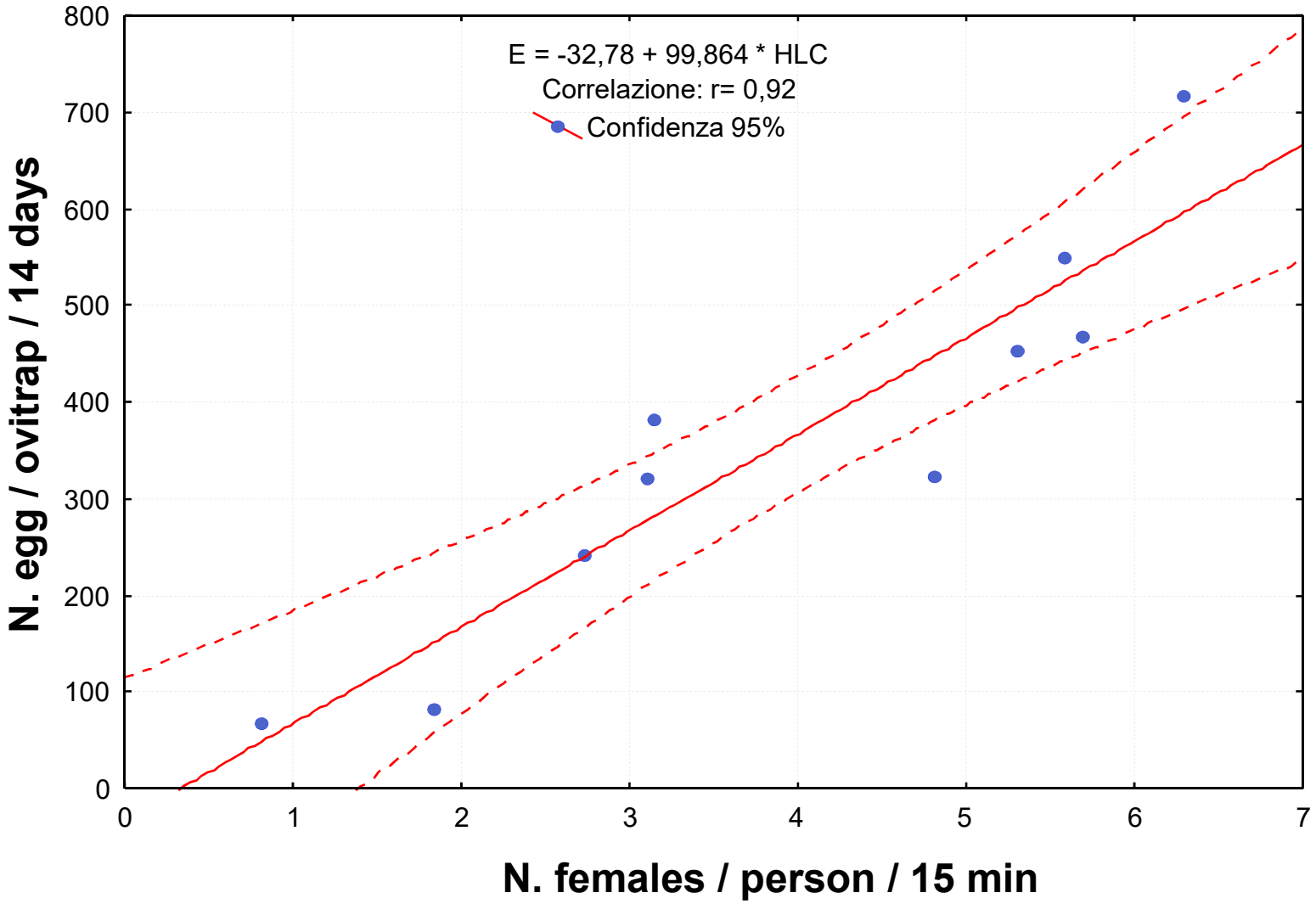
In the analysis of the captures on HLC data collected in Cesena and Rimini in the sample dates of August were excluded because in Cesena high wind speed registered from the local meteorological stations (> 3 m/s) that prevented the normal flight activity or the mosquito females and in Rimini adult mosquito control activity were conducted in sampling area.

Pearson product moment correlations (R) of the number of bites, the number of females and the number of eggs/ovitrap

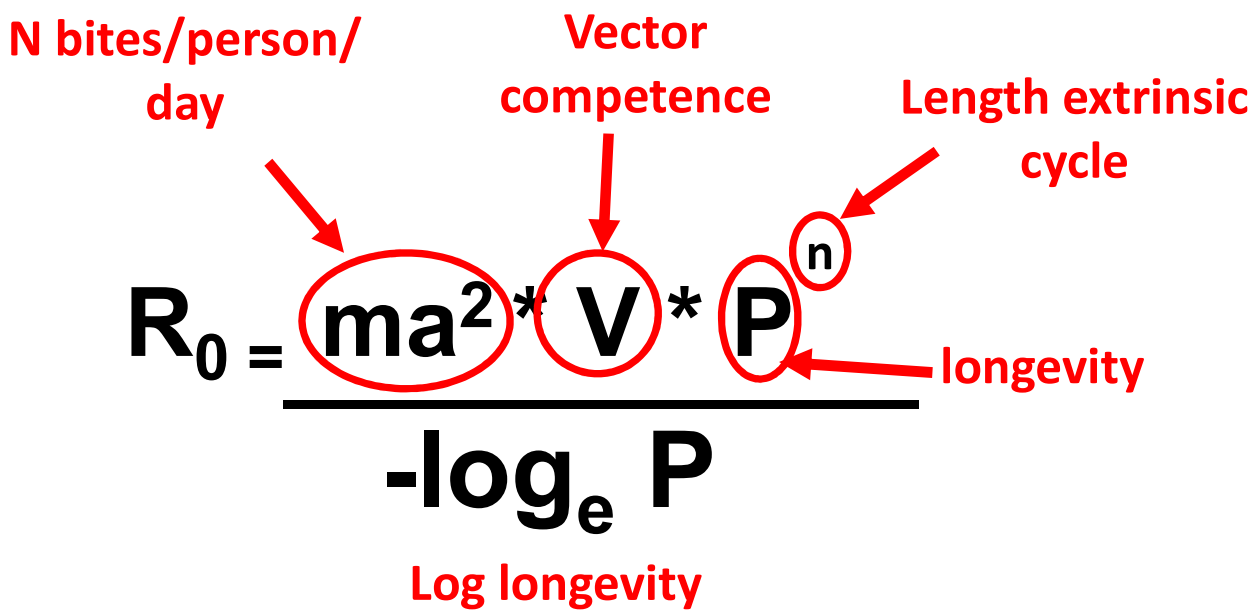
Sampling method	R values			
	Mean number of eggs		Mean number of eggs corrected with the population density	
	Previous week	Sampling week	Previous week	Sampling week
No. bites declared the day before the adult sampling	0.7024*	0.3862	0.7676**	0.5615
Adult sampling by HLC (No. females/15 min)	0.8178**	0.6624*	0.9201**	0.8105**

***p<0.05 and ** p<0.01**

Field data collected in Romagna 2008-2011



Epidemiological equation for VBD



from Fine 1981 & Reisen 1989

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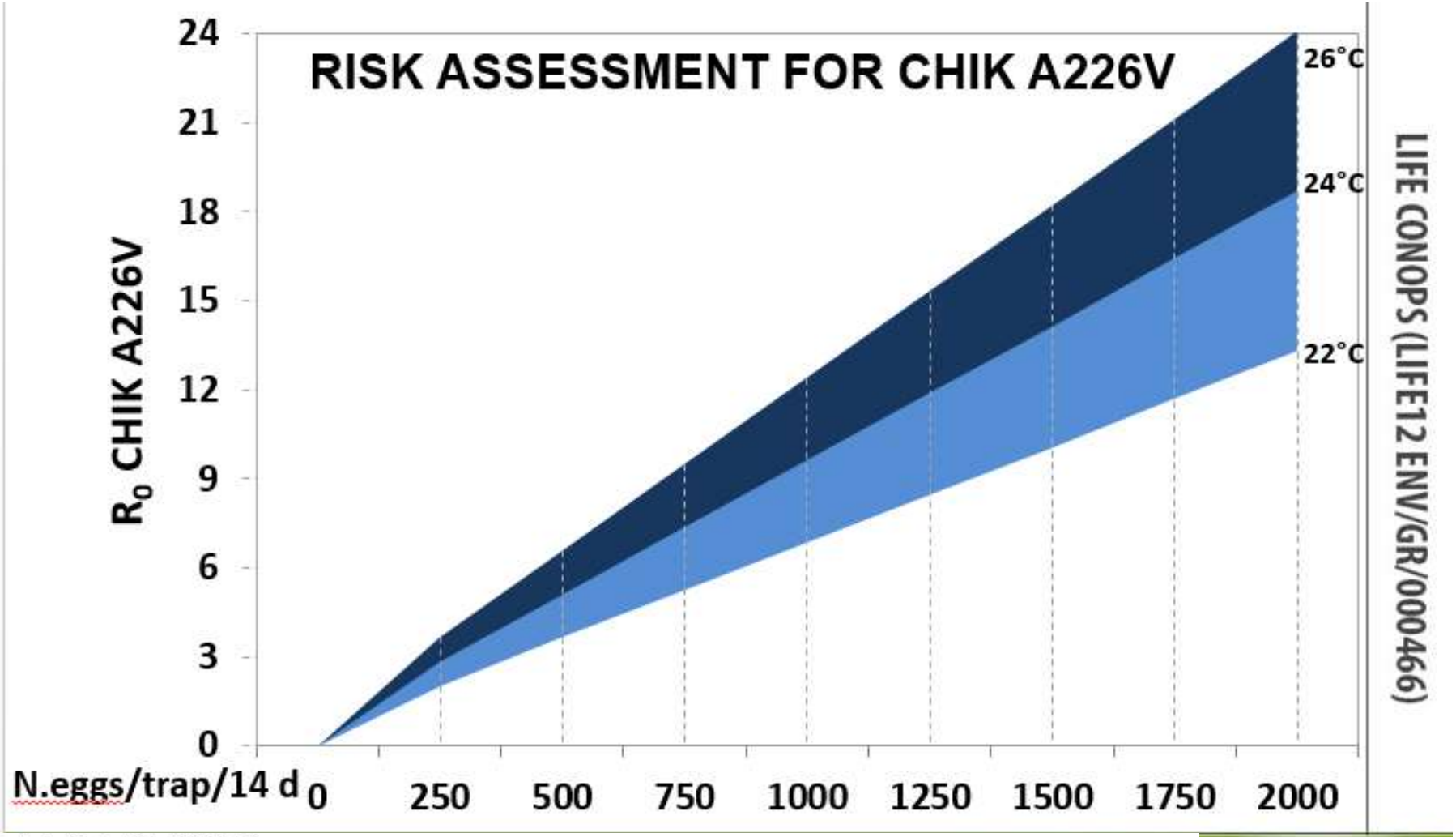
Parameter for R_0 calculation

Parameter	Label	Value	Reference
Multifeeding/gonotrophic cycle	*mF*	1.20	Hawley 1988
Host Feeding Pattern	*AI*	0.86-0.96	Valerio et al. 2010
Gonotrophic cycle	*GC*	4 - 11 days	Calculated in function of temperature by means the model of Focks et al. 1993.
Vector competence	*Sm*	Chik.: 24 – 80%	Vazeille et al. 2007 Talbalaghi et al. 2010 Mitchell 1991
Viremia	*V*	6 days	Peters and Dalrymple 1990 Boelle et al. 2008
Females daily survival rate	*p*	0.90	Hawley 1988 Willis and Nasci 1994 Almeida et al. 2005
Extrinsic incubation period	*i*	EIP=0.71GC	Dubrulle et al. 2009 Hawley 1988
Population susceptibility to Dengue and CHIKV	*Sv*	1	Moro et al. 2010
Vectorial capacity correction factor	X_V	0.101	Calculated
Bites per Egg Rate	*B*	PDS: 0.033 ± 0.015 HLC: 0.042 ± 0.021 NBC: 0.027 ± 0.028	Calculated

Epidemic risk threshold estimation based on mean egg density

Mean N eggs/14 gg	CHIK A226V	CHIK	DEN	ZIKA
< 100	$R_0<1$	$R_0<1$	$R_0<1$	$R_0<1$
101-250	$1<R_0<2$	$R_0<1$	$R_0<1$	$1<R_0<2$
251-400	$2<R_0<3$	$R_0<1$	$R_0<1$	$1<R_0<2$
401-700	$3<R_0<5$	$1<R_0<2$	$1<R_0<2$	$2<R_0<3$
701-1000	$5<R_0<7$	$1<R_0<2$	$1<R_0<2$	$3<R_0<5$
1001-1500	$7<R_0<10$	$2<R_0<3$	$2<R_0<3$	$3<R_0<5$
> 1501	$R_0>10$	$3<R_0<5$	$3<R_0<5$	$5<R_0<7$



Bellini et al., Vector Biol J 2016, 1:2
http://dx.doi.org/10.4172/vbj.1000108

Vector Biology Journal

Research Article

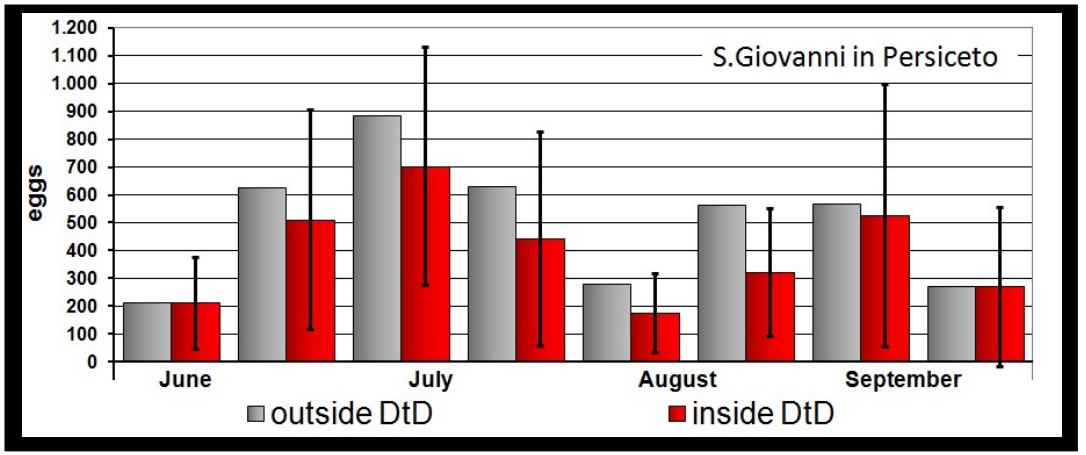
A SCITECHNOL JOURNAL

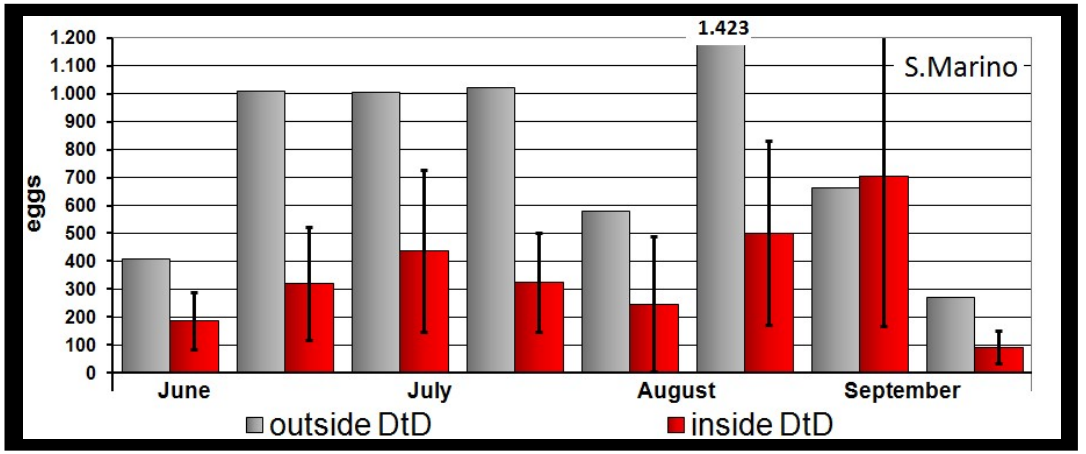
Chikungunya and Dengue Risk Assessment in Greece

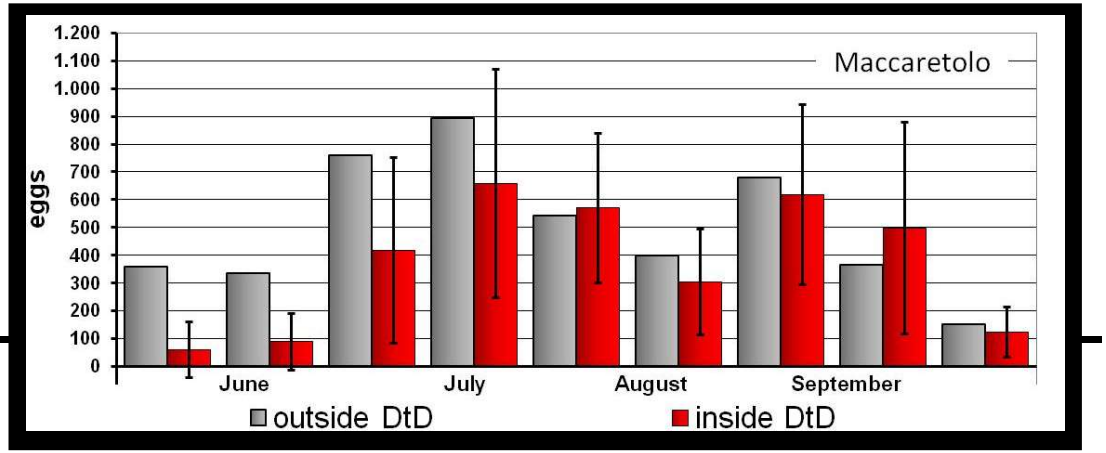
invasive mosquito species (IMS) were inadvertently introduced in Europe, where they found favorable environmental conditions enhanced by the climate change [1]. The predicted increases in temperature (1.4 to 5.8°C by 2100) and rainfall are likely to extend

MOSQUITO CONTROL EFFICACY EVALUATION BY OVITRAPS

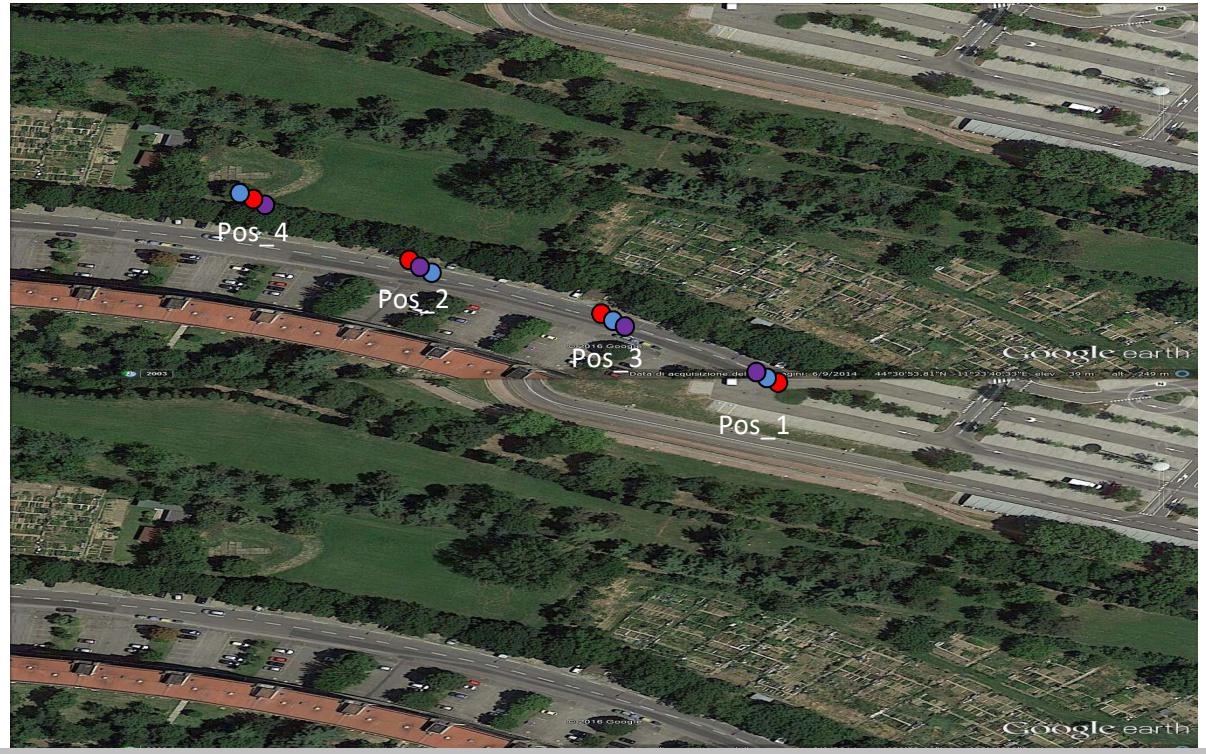
Aedes albopictus
egg density in ovitraps in control areas
Vs
Door-to-Door areas



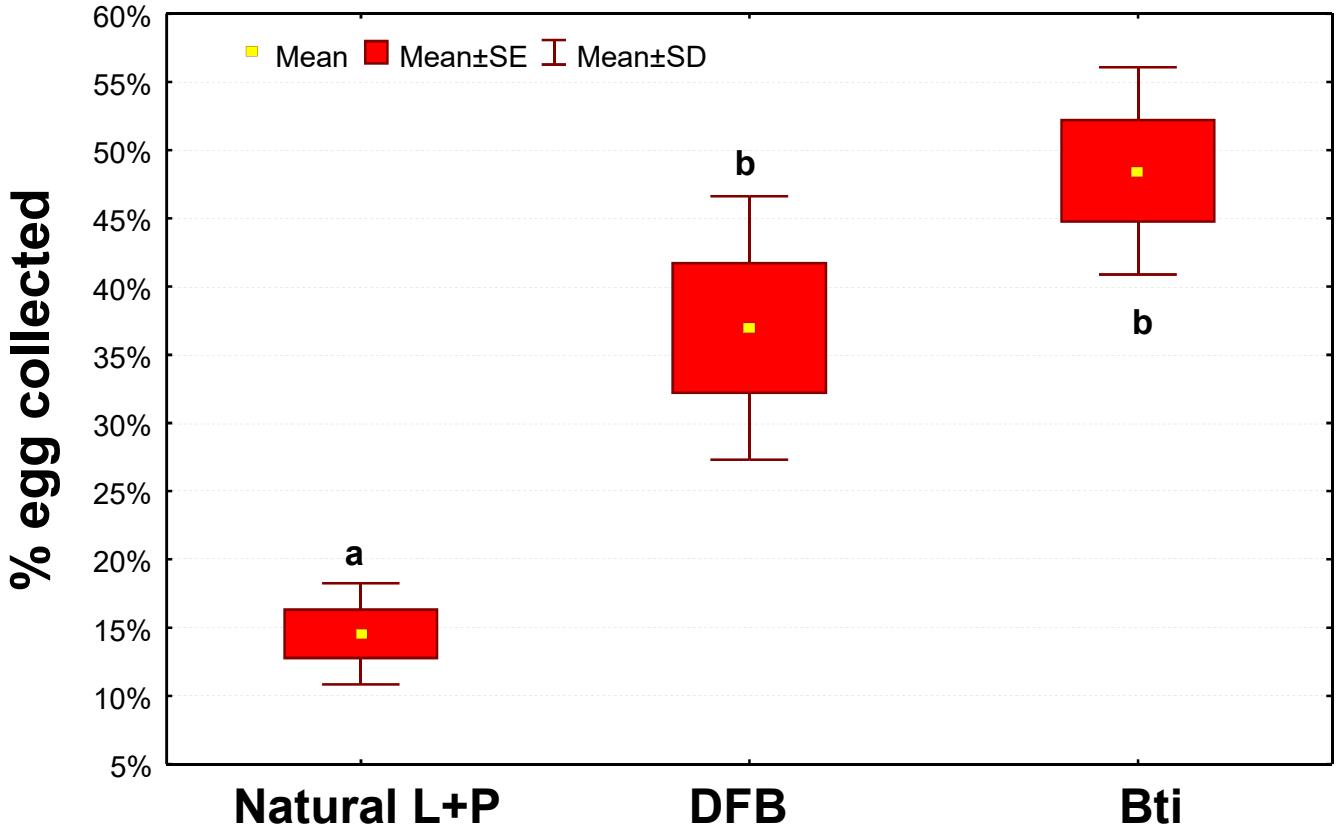




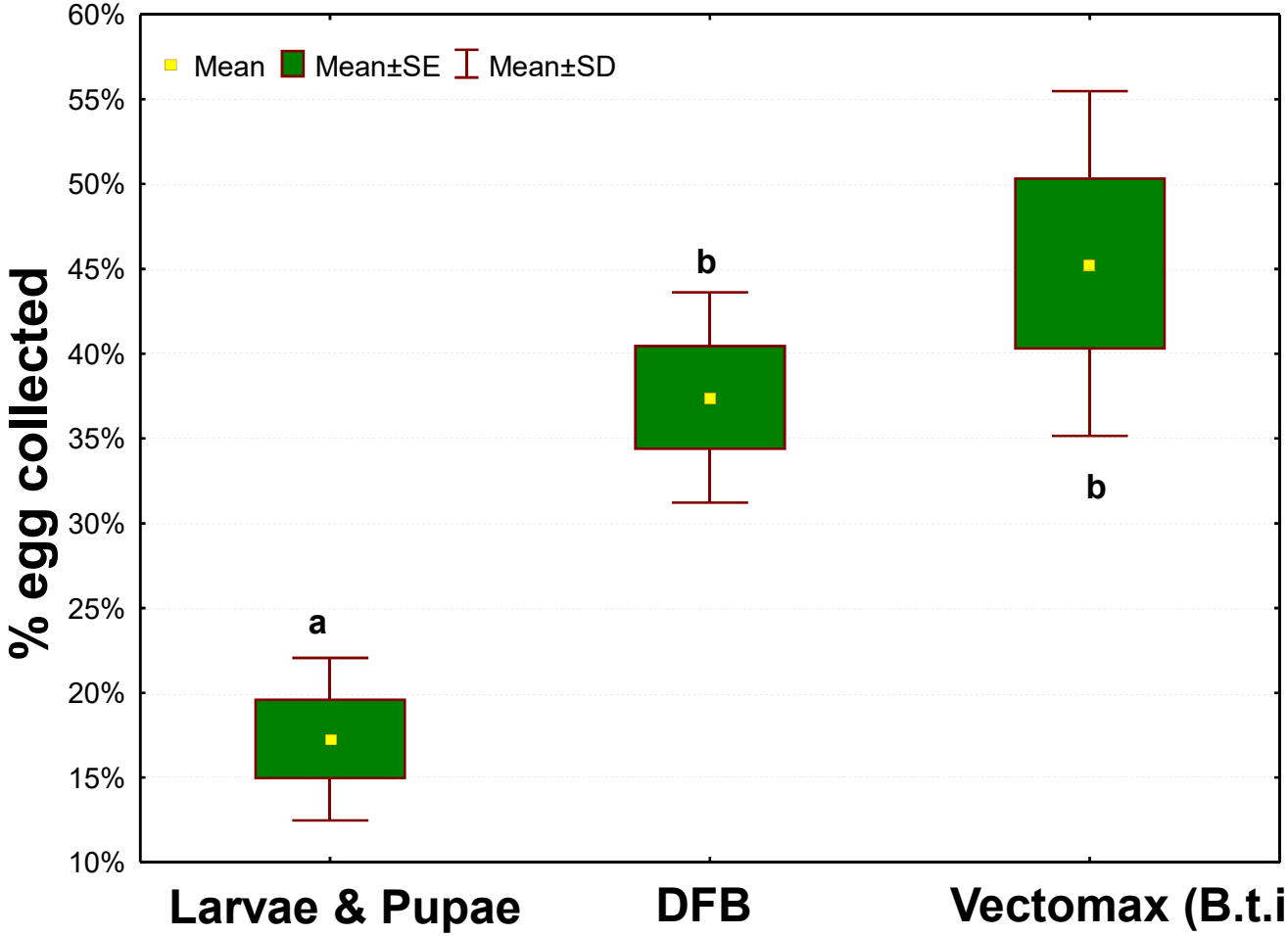
OVITRAP – influence of Diflubenzuron, *B.t.i.* and *B.sphaericus* - 2016



	16-giu	23-giu	30-giu	07-lug	14-lug	21-lug	28-lug	04-ago	11-ago	25-ago	08-set
Management											
Add water											
Add product	**DFB Bti**				**DFB Bti+Bs**				**DFB Bti**		

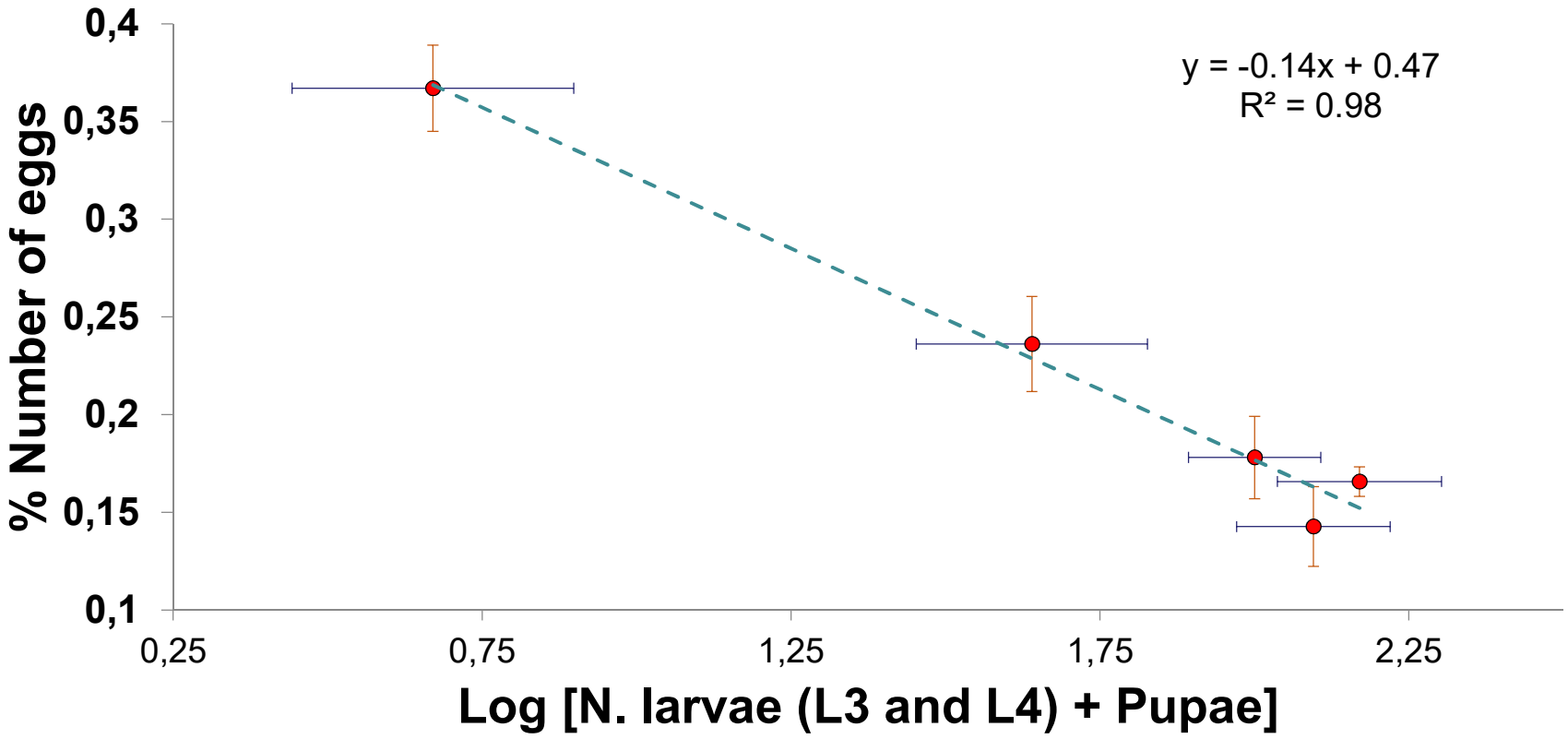


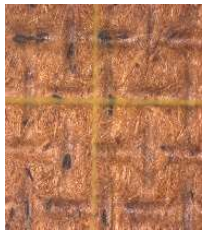
	N	Means	S.D.	Test N-K
Larvae & Pupae	4	14.55%	3.71%	a
Diflubenzuron (0.1 mg/ovitrap)	4	36.97%	9.66%	b
B.t.i. (0.5 mg/ovitrap)	4	48.48%	7.59%	b



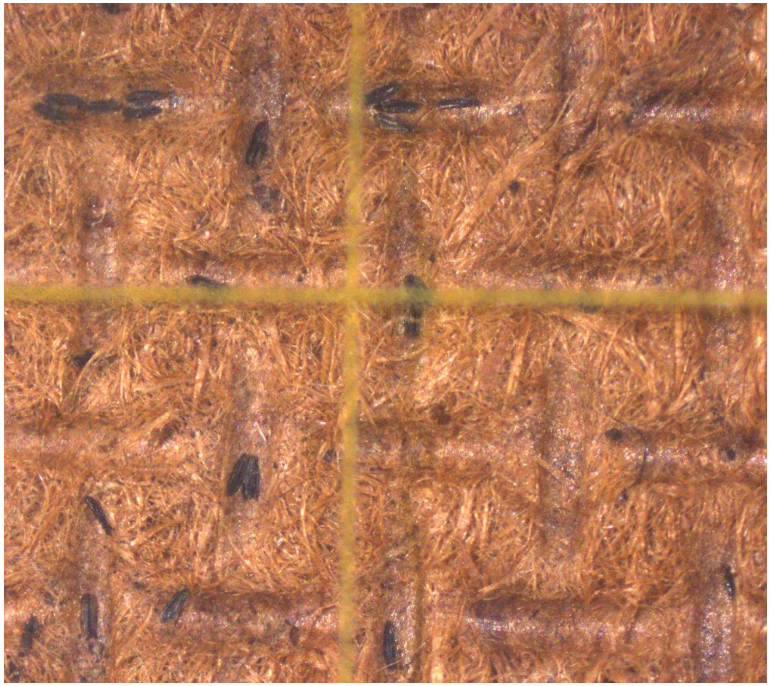
P	N	Means	Std.Dev.	Test N-K
Larvae and Pupae	4	17.3%	4.78%	a
Diflubenzuron (0.1 mg)	4	37.4%	6.21%	b
Vectomax (B.t.i. + B.s.) (5 mg)	4	45.3%	10.17%	b
All Grps	12	33.3%	14.03%	


WATER: – Larve of Ae.albopictus
B.t.i+B.s. – Larve of Sirfids
DFB – Organic matter


y = -0.14x + 0.47
R² = 0.98
% Number of eggs
0,4
0,35
0,3
0,25
0,2
0,15
0,1
0,25
0,75
1,25
1,75
2,25
Log [N. larvae (L3 and L4) + Pupae]



Reducing time in the Aedes egg counting 2016



A1	B1	C1	D1
A2	B2	C2	D2
A3	B3	C3	D3
A4	B4	C4	D4

The cost of monitoring ?

- about 4 % of the total budget Aedes albopictus plan (3 ML €)

- The Emilia-Romagna Region is paying 100% the monitoring

Monitoring by ovitraps

STRENGTH

- Low management cost
- Good spatial analysis
- Serving risk assessment
- Long term evaluation

WEAKNESSES

- it require field management quality
- comparison between different ecological condition not directly proportional


I am coming !!!