Cambodia – Medical Entomology

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ECOMORE II

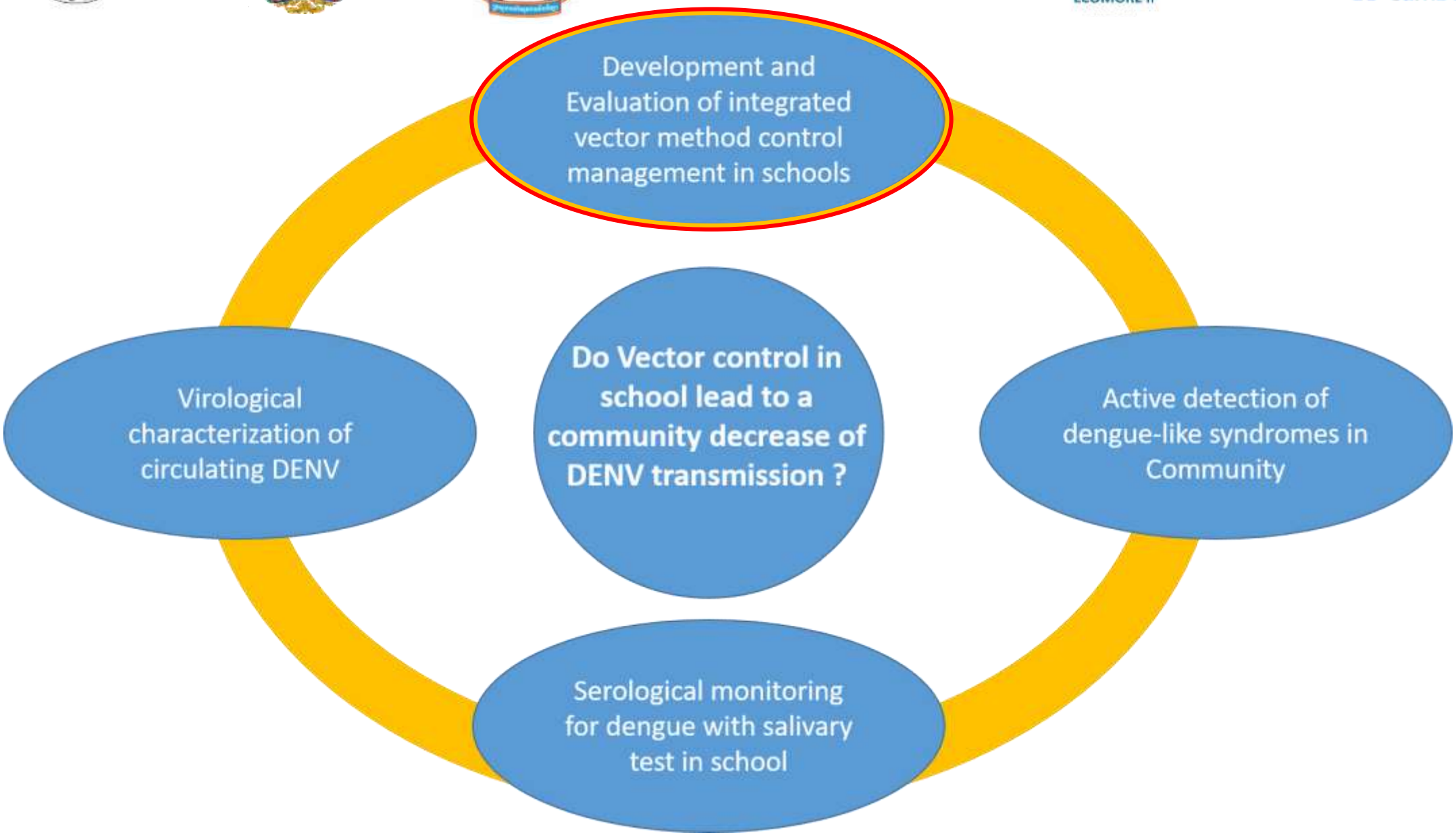
AFD
AGENCE FRANÇAISE DE DÉVELOPPEMENT

Institut Pasteur

international network Institut Pasteur

Institut Pasteur du Cambodge

WP CAMBODIA


Development and Evaluation of integrated vector method control management in schools
Active detection of dengue-like syndromes in Community
Serological monitoring for dengue with salivary test in school
Virological characterization of circulating DENV
Do Vector control in school lead to a community decrease of DENV transmission ?

Development and Evaluation of integrated vector method control management (IVM) in schools

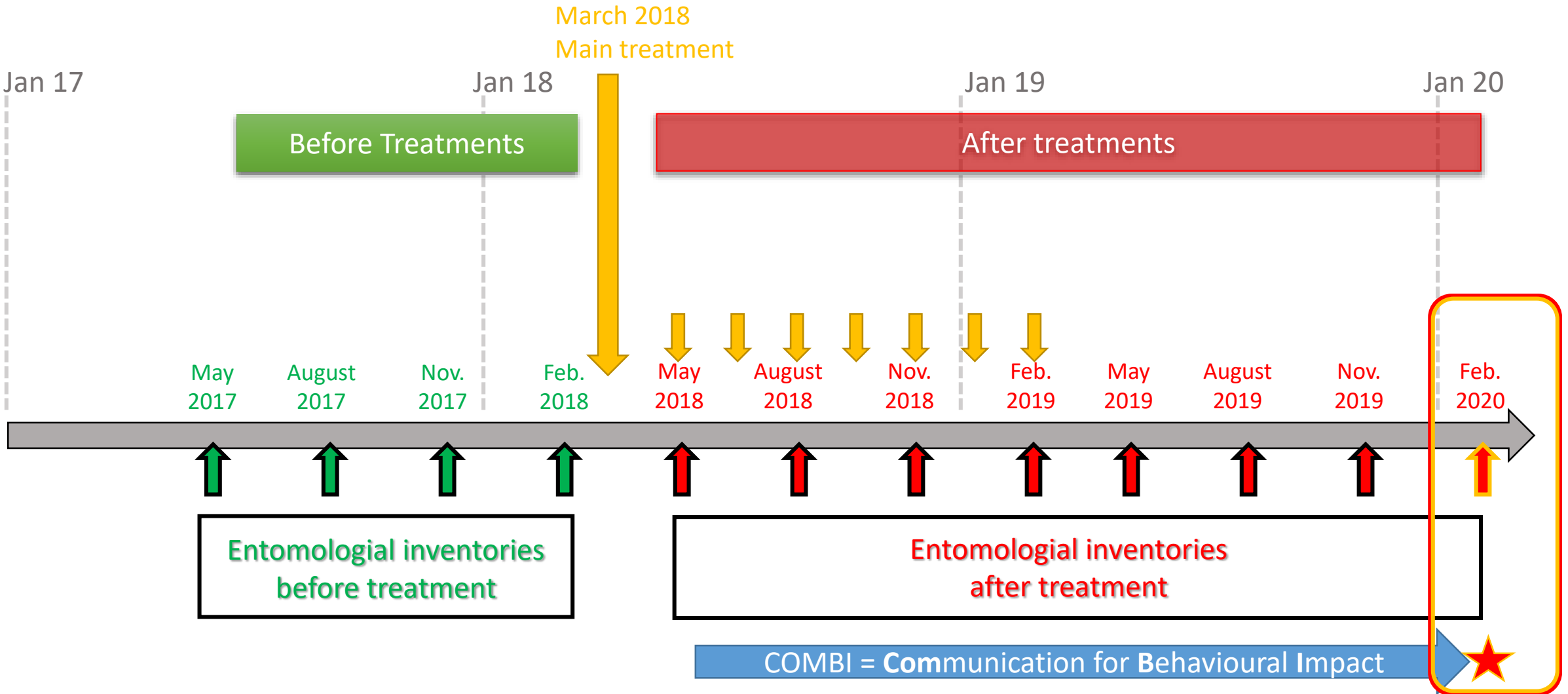
MAIN QUESTION

- Do the IVM decrease the population of *Aedes aegypti*?

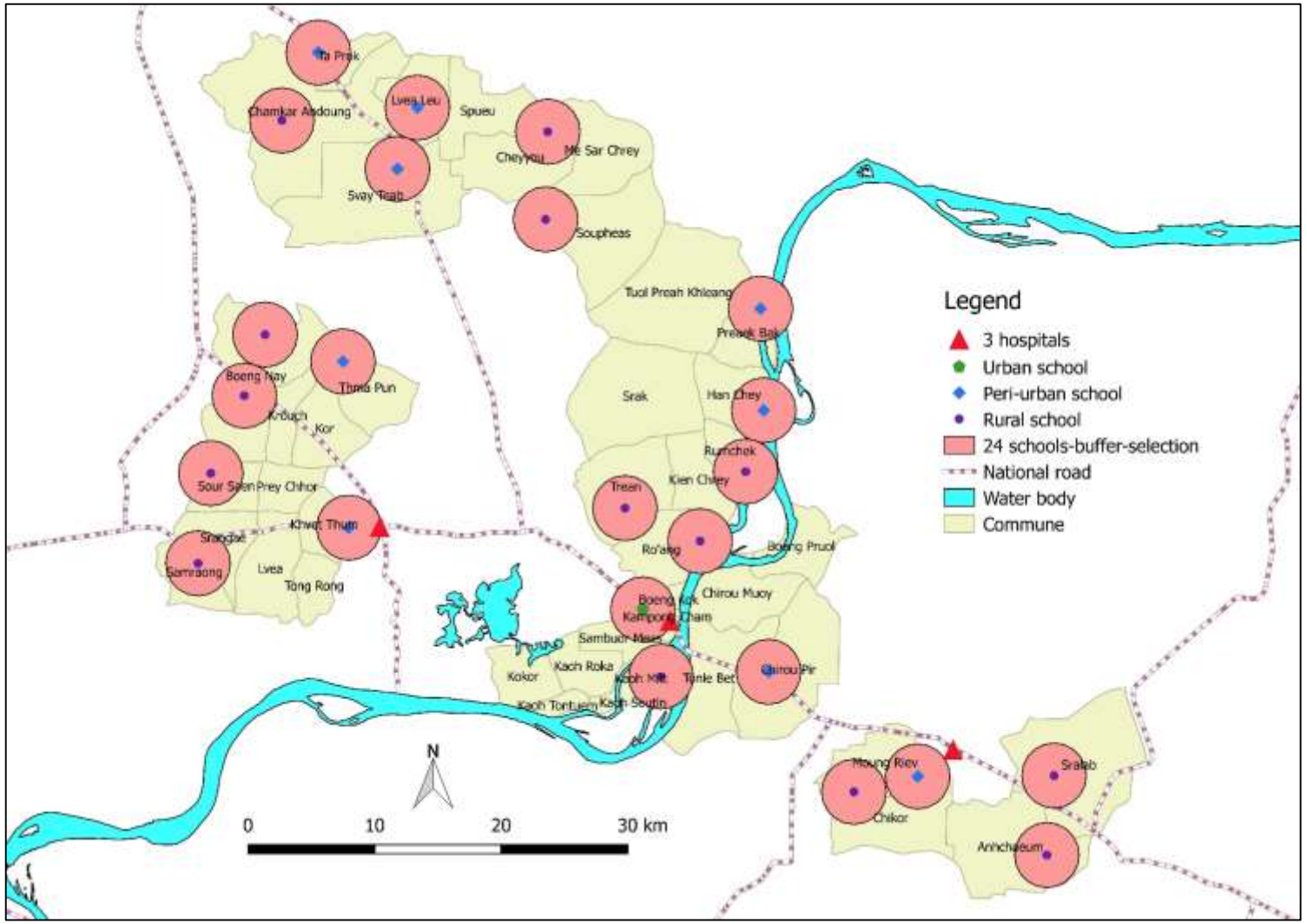
RELATED QUESTIONS

- Is the density of *Aedes aegypti* the same in the 2 clusters before treatment ?
- What is the mosquito composition species ?
- What are the breeding sites in/around schools ?
- Are *Aedes aegypti* resistant to insecticides ?

To set up an integrated vector control strategy in schools



Distribution of 24 schools in Kampong Cham & Tbong Khmum provinces



HIGH BIODIVERSITY !

13 genus
> 69 species

Aedeomyia catasticta

Aedes aegypti
Aedes albopictus
Aedes lineatopennis
Aedes malayensis
Aedes vexans
Aedes w-alba

Anopheles aconicus
Anopheles annularis
Anopheles argyporus
Anopheles barbirostris
Anopheles barbumbrosus
Anopheles campestris
Anopheles campe/barbirostris
Anopheles crawfordi
Anopheles hodgkini
Anopheles indefinitus

Anopheles nigerrimus

Armigeres theobaldi

Coquillettidia crassipes
Coquillettidia ochracea
Coquillettidia sp1

Culex bitaeniorhynchus
Culex brevipalpis

Culex vishnui.g
Culex whitmorei
Culex wilfredi
Culex sp1
Culex sp2
Culex sp3

Lutzia fuscana
Lutzia halifaxii
Lutzia vorax

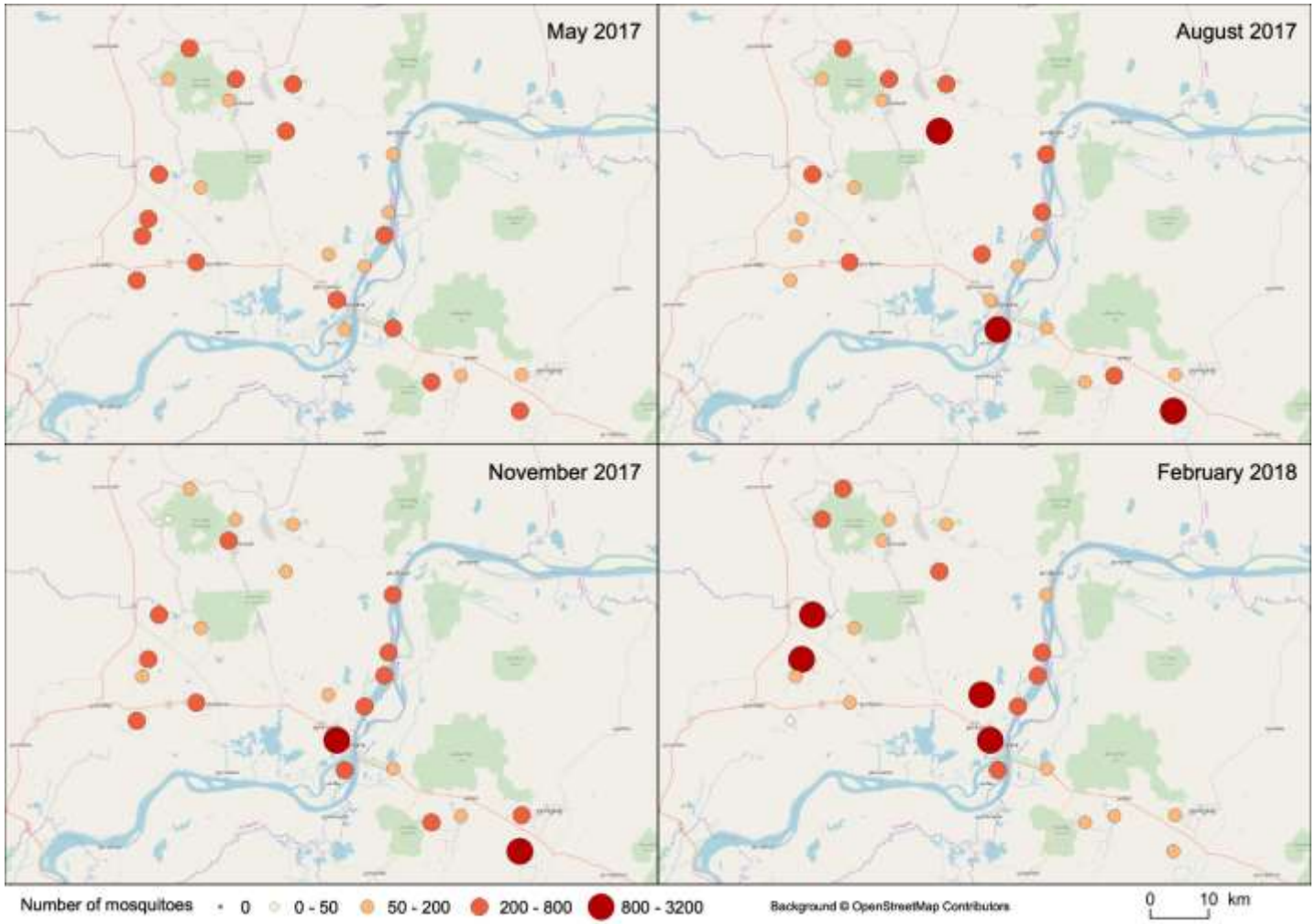
Mansonia annulifera
Mansonia indiana

Tripteroides sp1

Uranotaenia lateralis / subnormalis
Uranotaenia micans
Uranotaenia nivipleura
Uranotaenia rampae

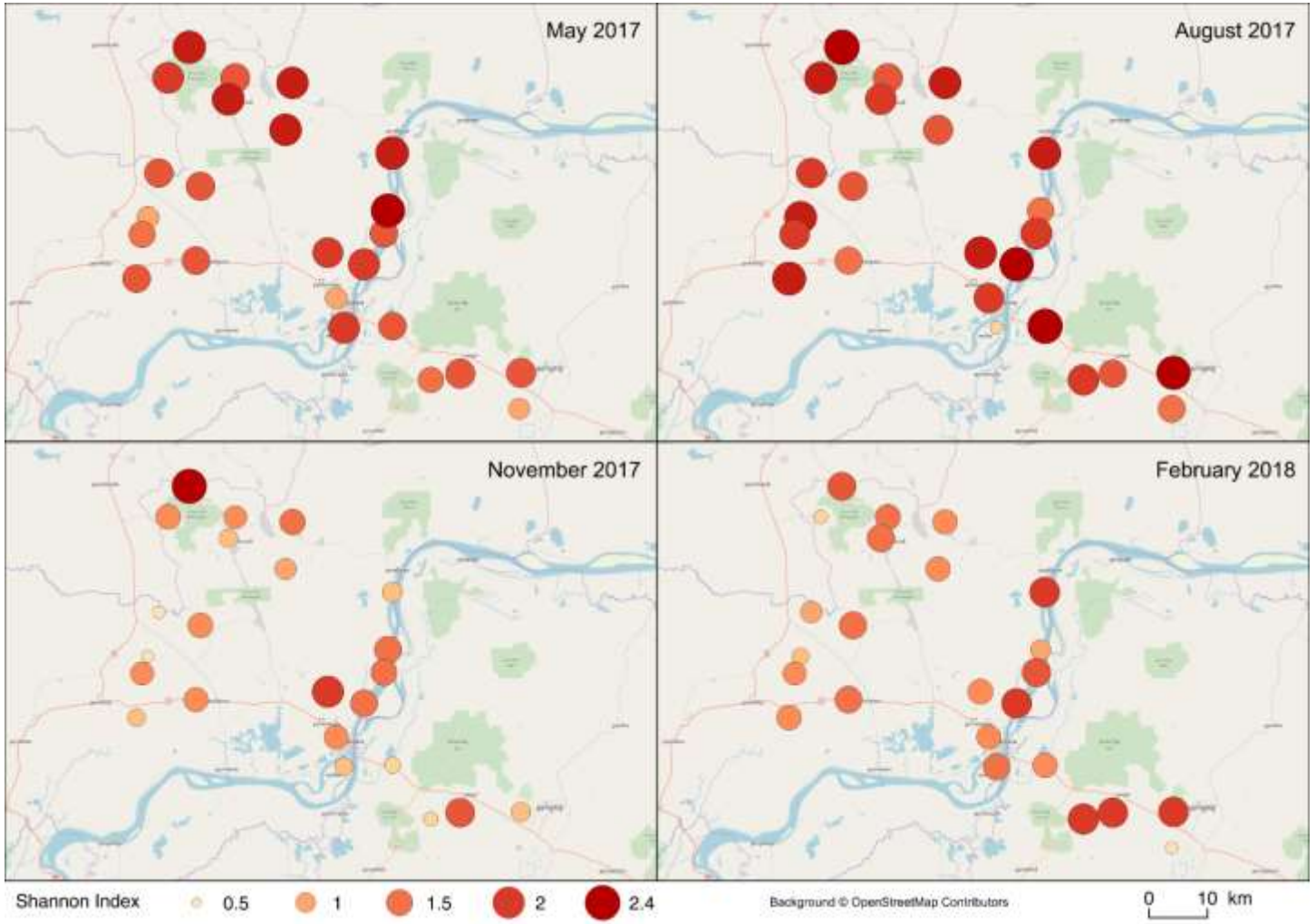
6 potential **JEV** vector species	20,139 mosquitoes (69%)
6 potential **RVF** vector species	4,630 mosquitoes (16%)
5 potential **WNF** vector species	4,251 mosquitoes (15%)
4 potential **RRV** vector species	3,750 mosquitoes (13%)
3 potential **malaria** vector species	3,449 mosquitoes (12%)
3 potential **ZIKV** vector species	3,094 mosquitoes (11%)
3 potential **DENV** vector species	1,112 mosquitoes (4%)

All mosquitoes – Year 1 before vector control management



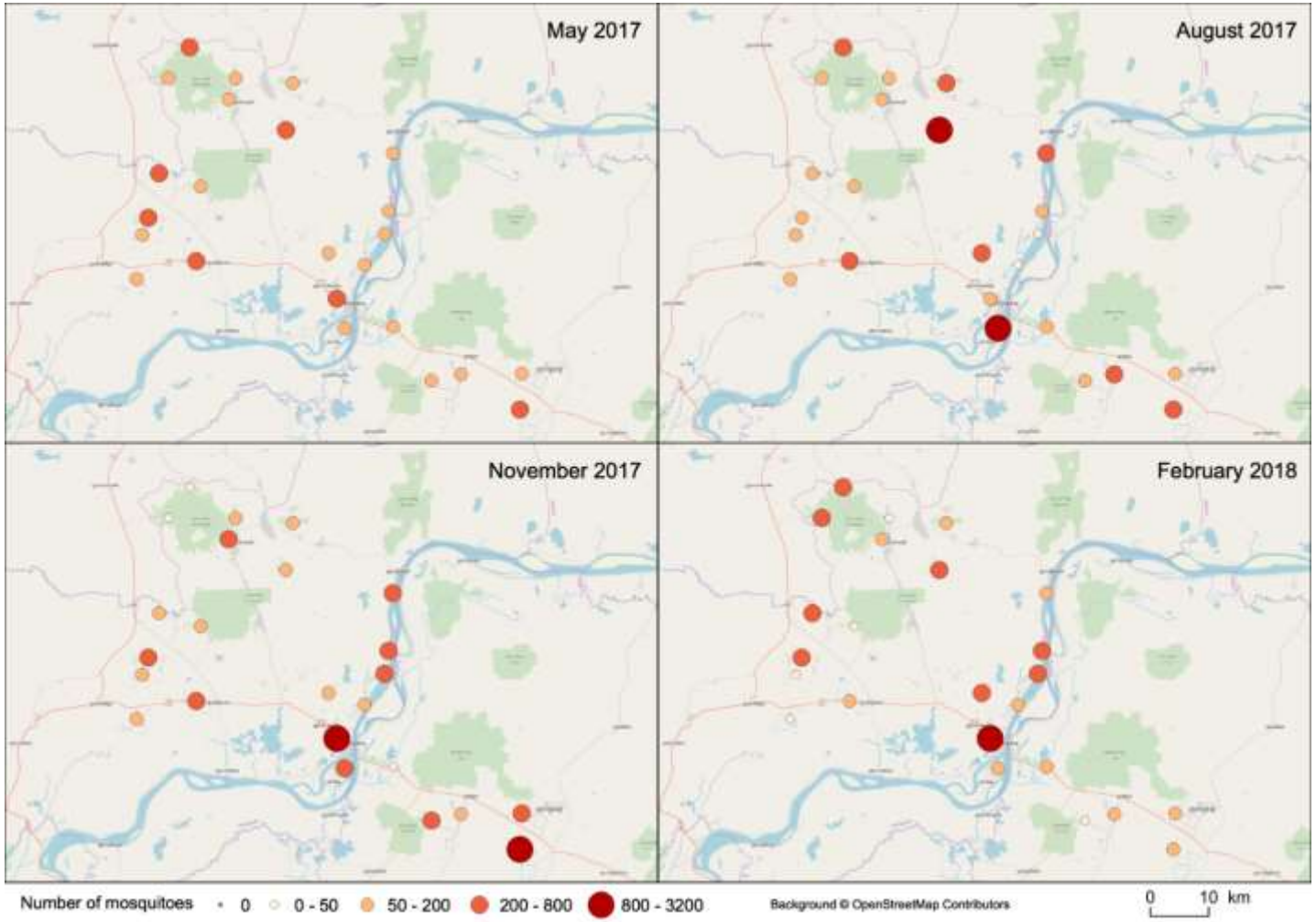
- Seasonal effect
- Spatial effect

Biodiversity of mosquitoes (Shannon index) – Year 1 before vector control management

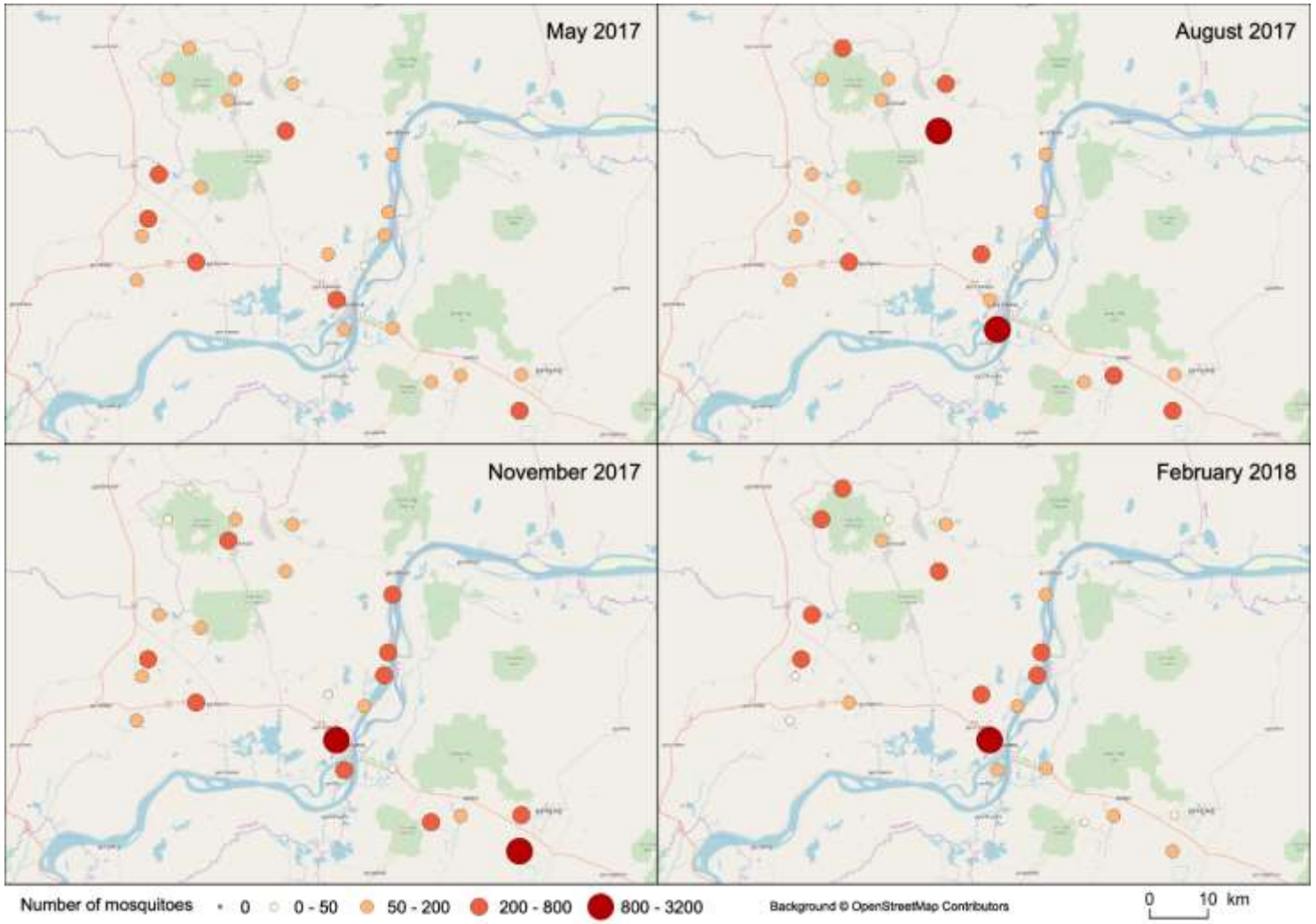


- Effect of landscape use on biodiversity
- Effect of climate on biodiversity

All vectors – Year 1 before vector control management



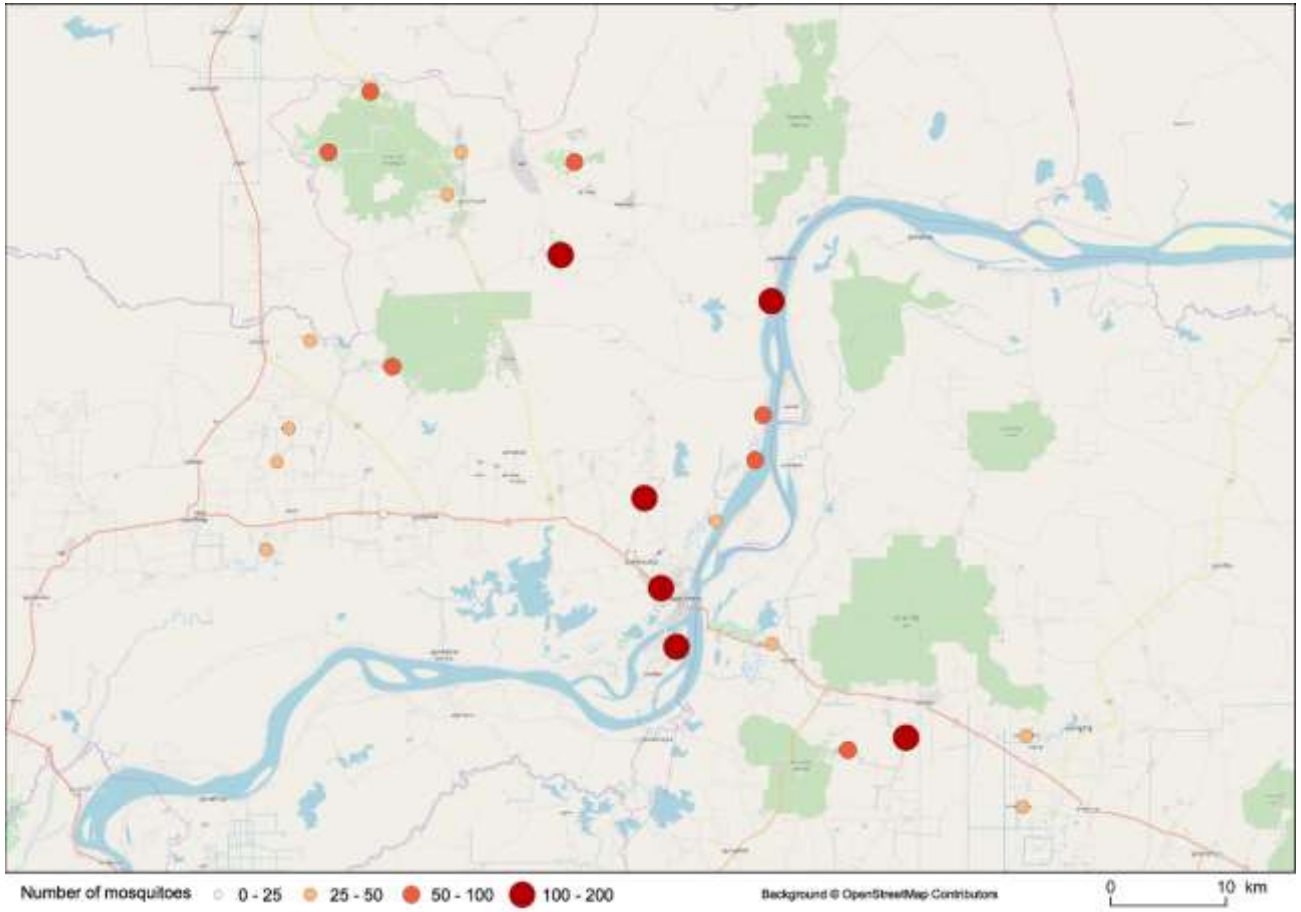
Japanese encephalitis virus' vectors – Year 1 before vector control management



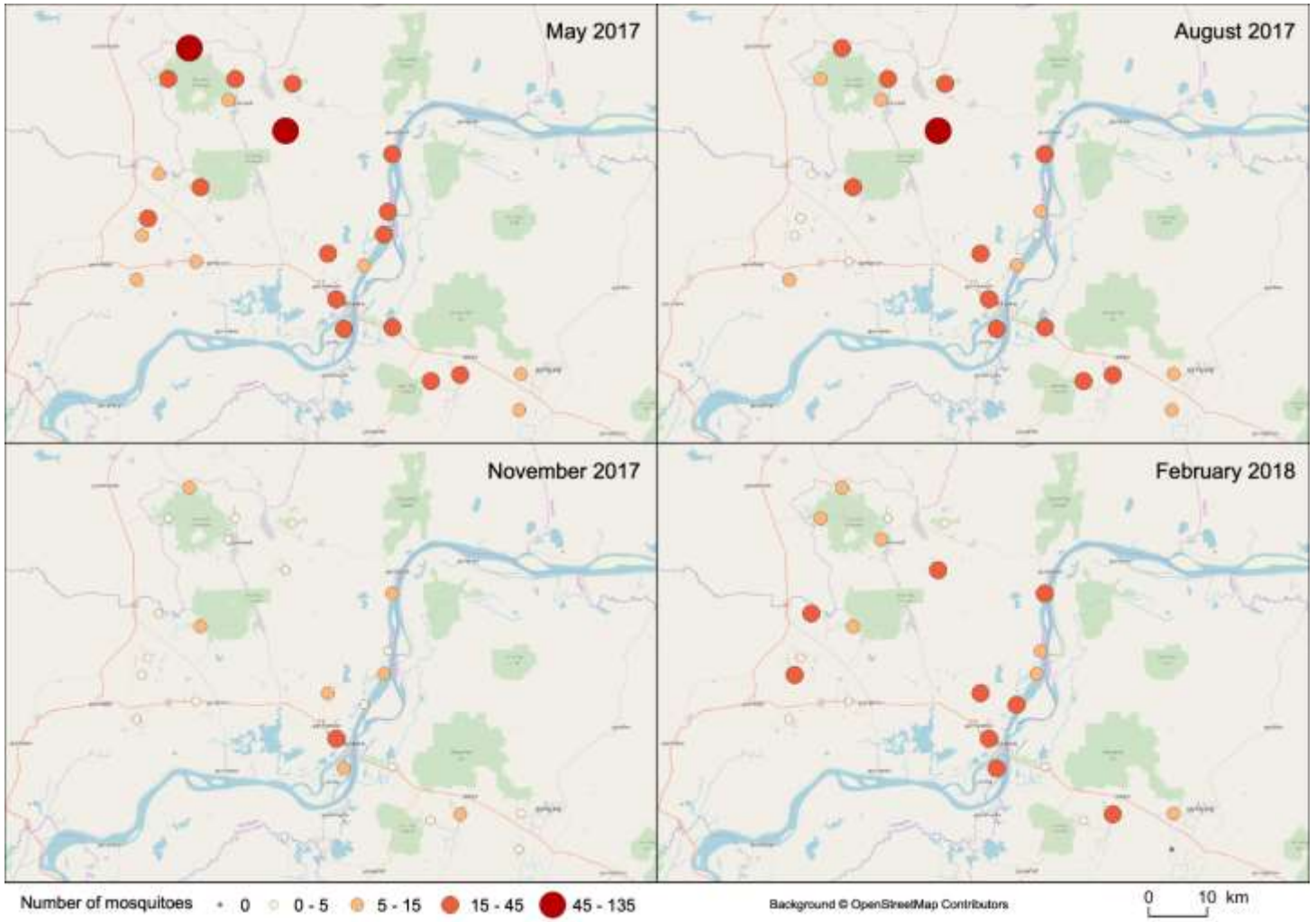
- Effect of landscape use
- Effect of climate

→ Map of risk !

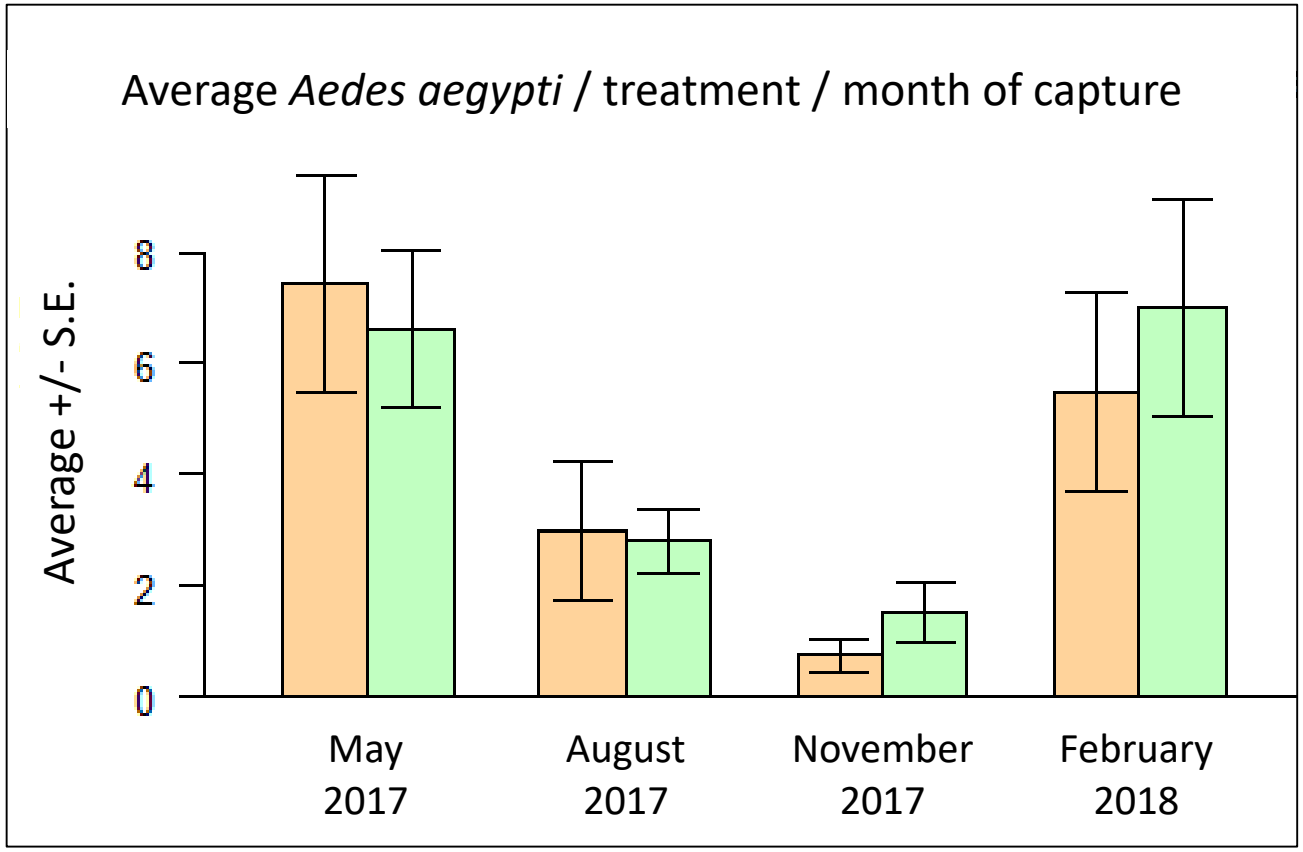
Dengue virus' vectors – Year 1 before vector control management

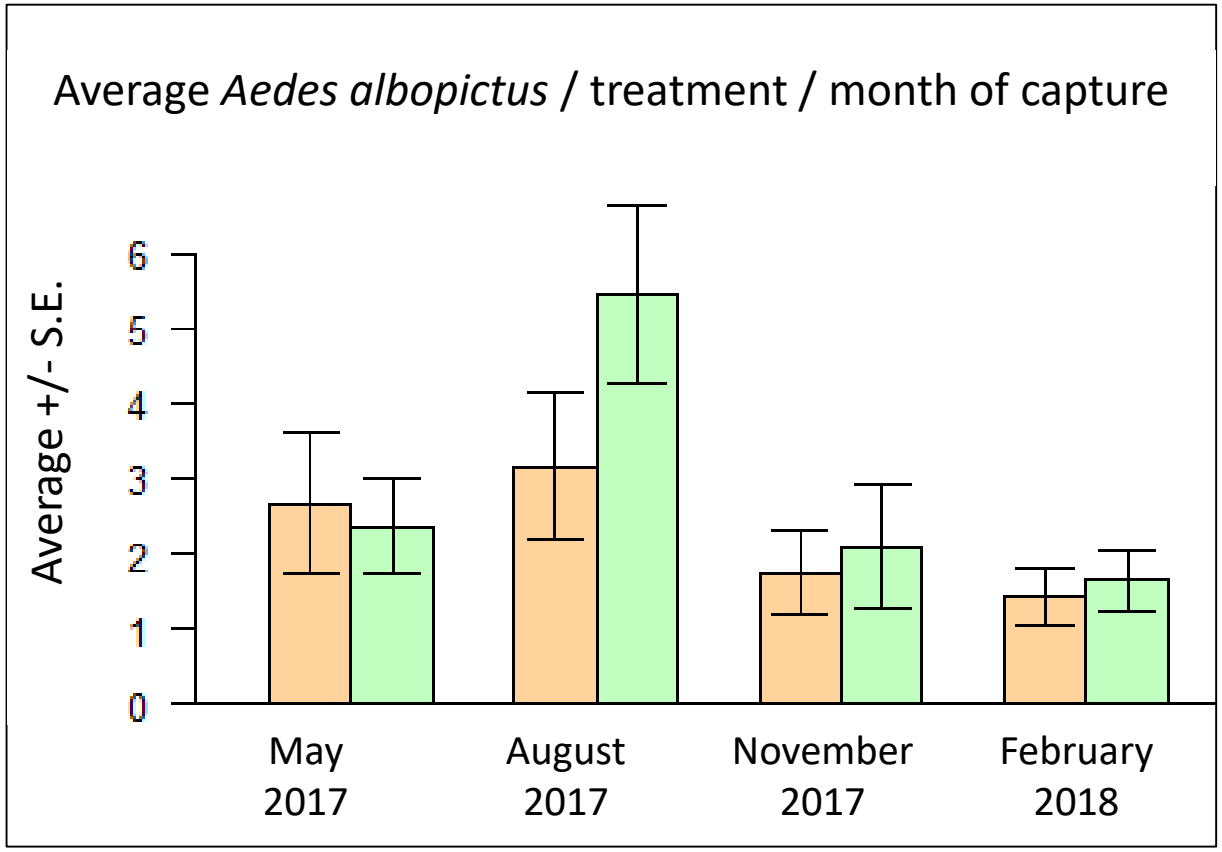


Dengue virus' vectors – Year 1 before vector control management



Dengue virus' vectors – Year 1 before vector control management

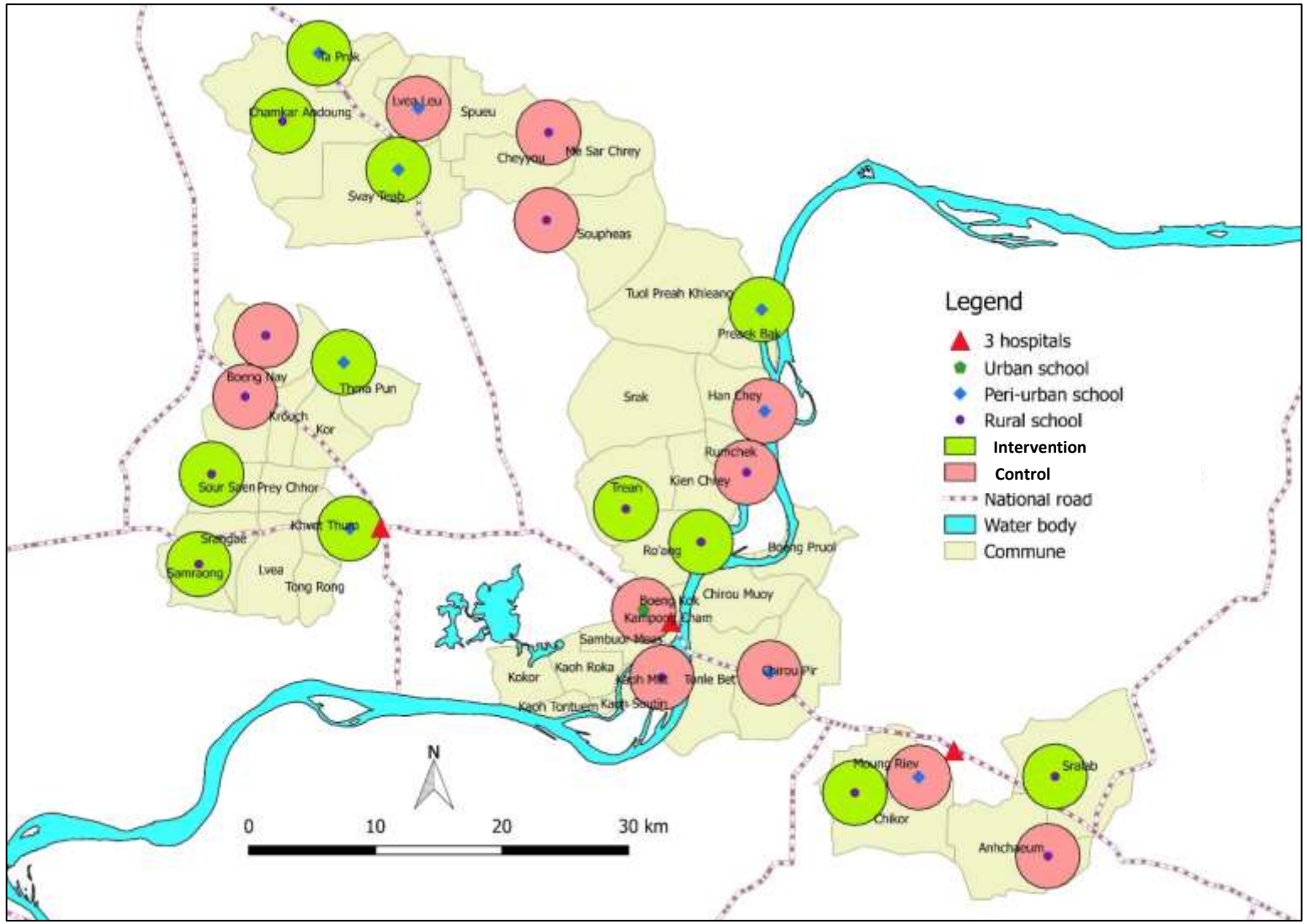




- Seasonality of *Aedes aegypti*
- No difference between the 2 areas

- Different seasonality of *Aedes albopictus*
- No difference between the 2 areas

Dengue virus' vectors – Year 1 before vector control management



Integrated Vector Control Management

1. Communication & Knowledge
2. Destruction of breeding sites
3. Use of larvicide *Bti*
4. in2care traps in schools (auto-dissemination)

Integrated Vector Control Management – Communication & knowledge

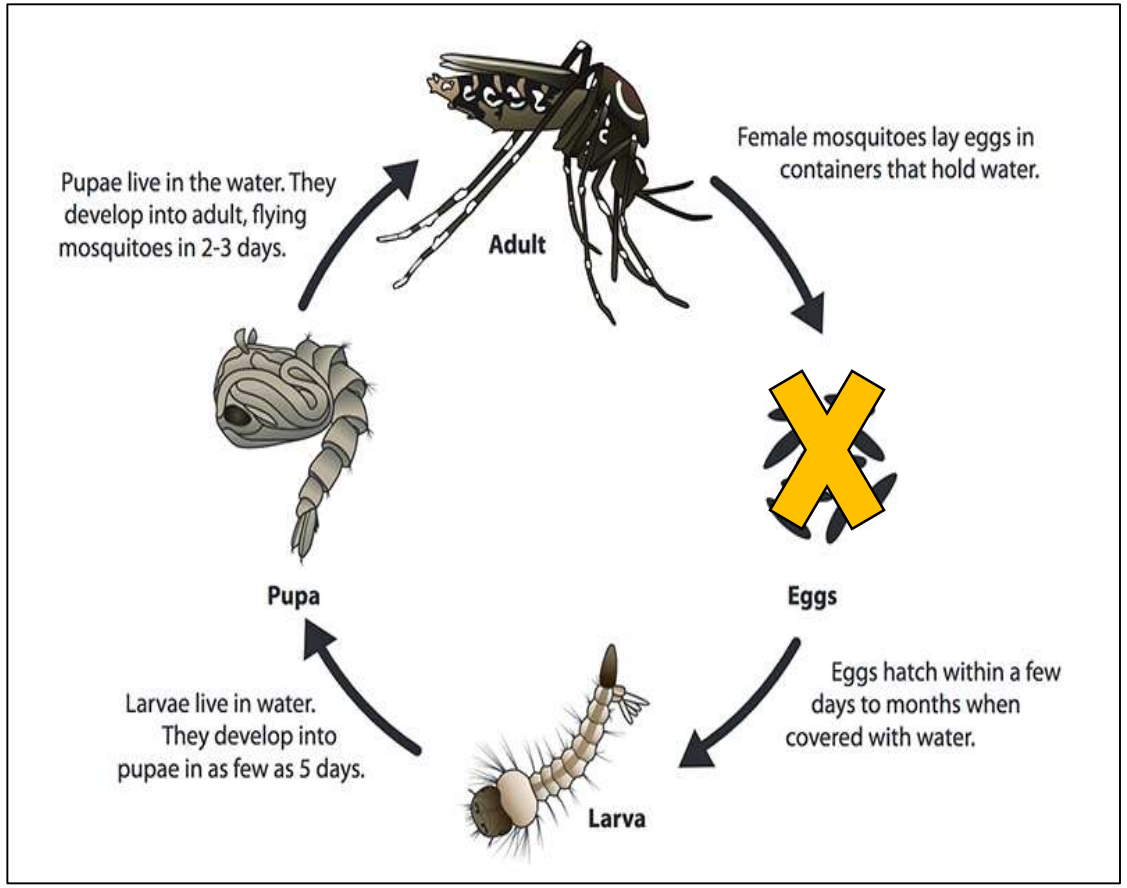
Integrated Vector Management – Communication & knowledge

Distribution & explanation of the 2nd poster in all schools (2 or 3 posters per schools)

Integrated Vector Control Management

1. Communication & Knowledge
2. Destruction of breeding sites
3. Use of larvicide *Bti*
4. in2care traps in schools (auto-dissemination)

Integrated Vector Control Management – Physical destruction of small breeding sites



Physical destruction

Integrated Vector Control Management – Physical destruction of small breeding sites

Before

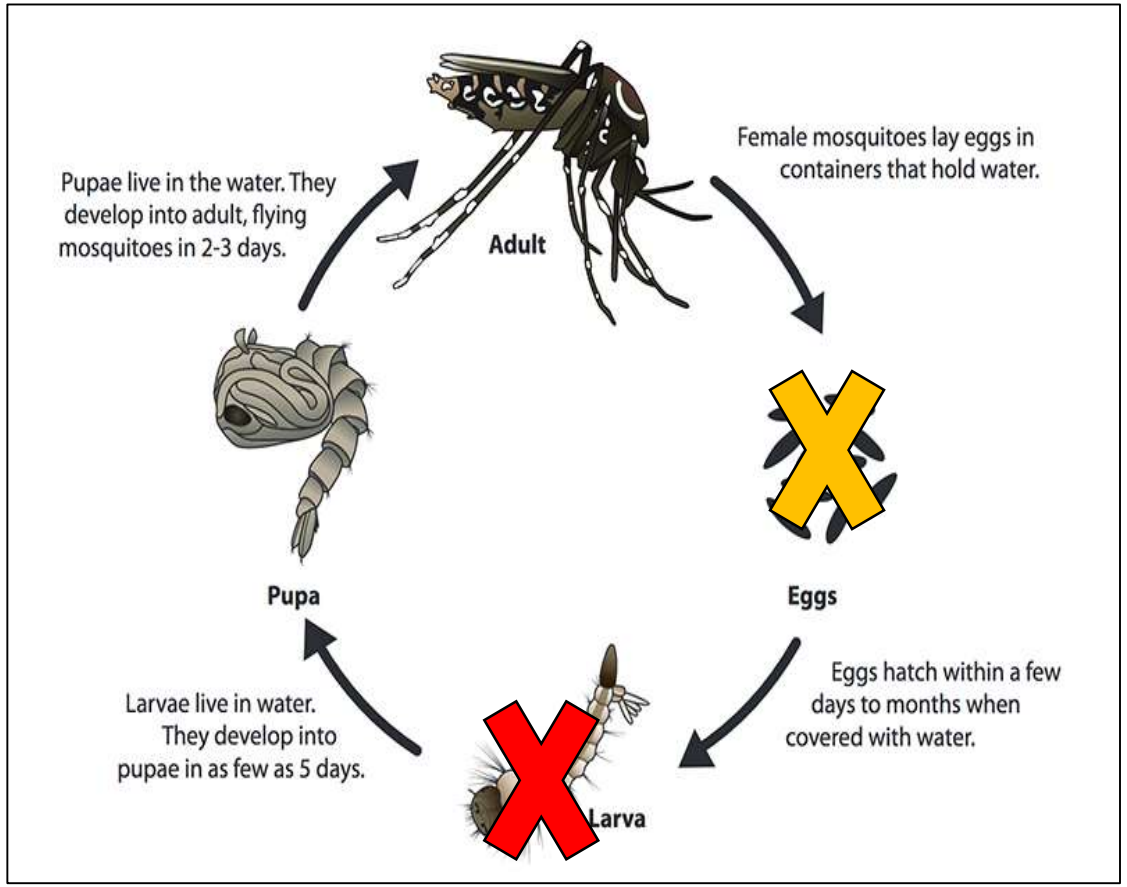
Integrated Vector Control Management – Physical destruction of small breeding sites

After

Integrated Vector Control Management – Physical destruction of small breeding sites

Involvement of Children

Integrated Vector Control Management – Use of larvicide : Bti



Use of *Bti*

Physical destruction

Integrated Vector Control Management – Use of larvicide : Bti

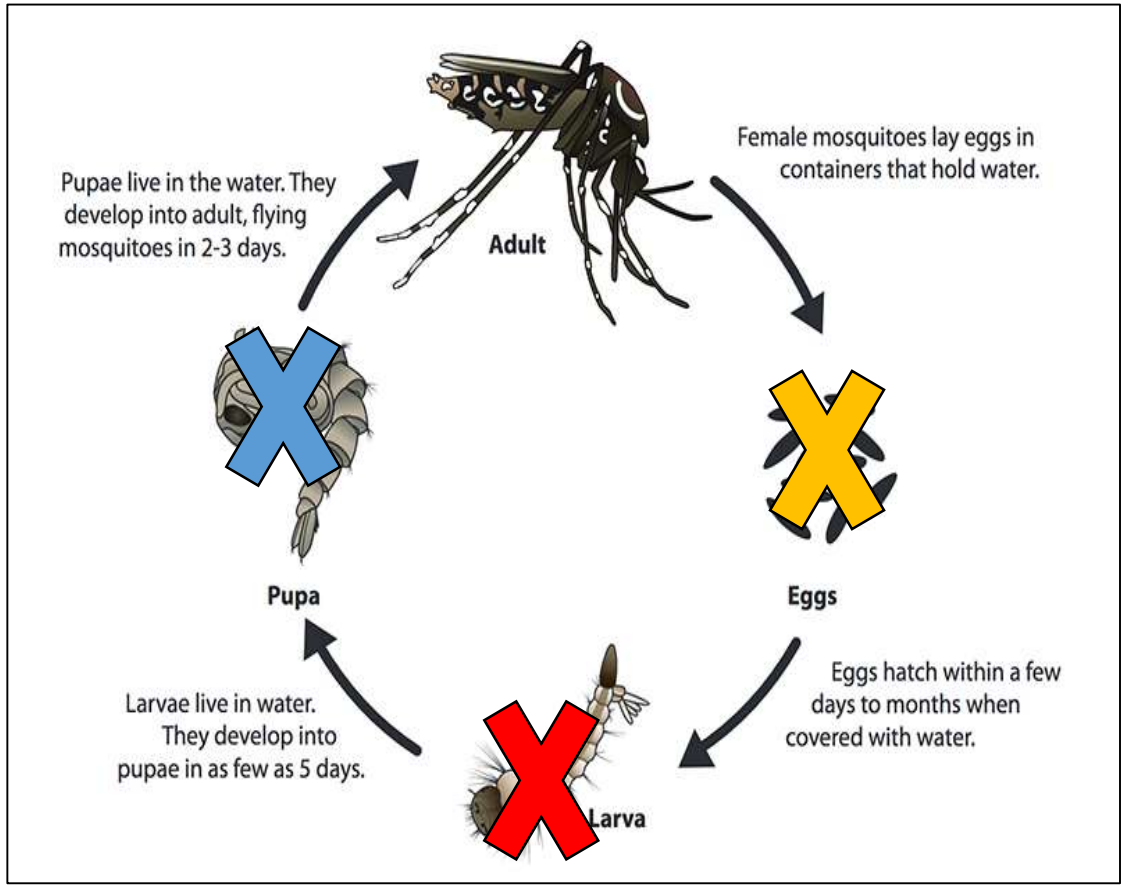
Bti treatment area

Integrated Vector Control Management – Use of larvicide : Bti

Integrated Vector Control Management – Use of larvicide : Bti

Inventory of main breeding sites IN and AROUND the schools

Integrated Vector Control Management – Use of autodessimination adulticide : in2care © traps



Use of *Bti*

Physical destruction

Pyriproxyfen autodissemination (in2care traps)

Integrated Vector Control Management – Use of autodessimination adulticide : in2care © traps

Integrated Vector Control Management – Use of autodessimination adulticide : in2care © traps

Presentation and explanation of in2care traps in each classroom

Integrated Vector Control Management – Use of autodessimination adulticide : in2care © traps

Set Up

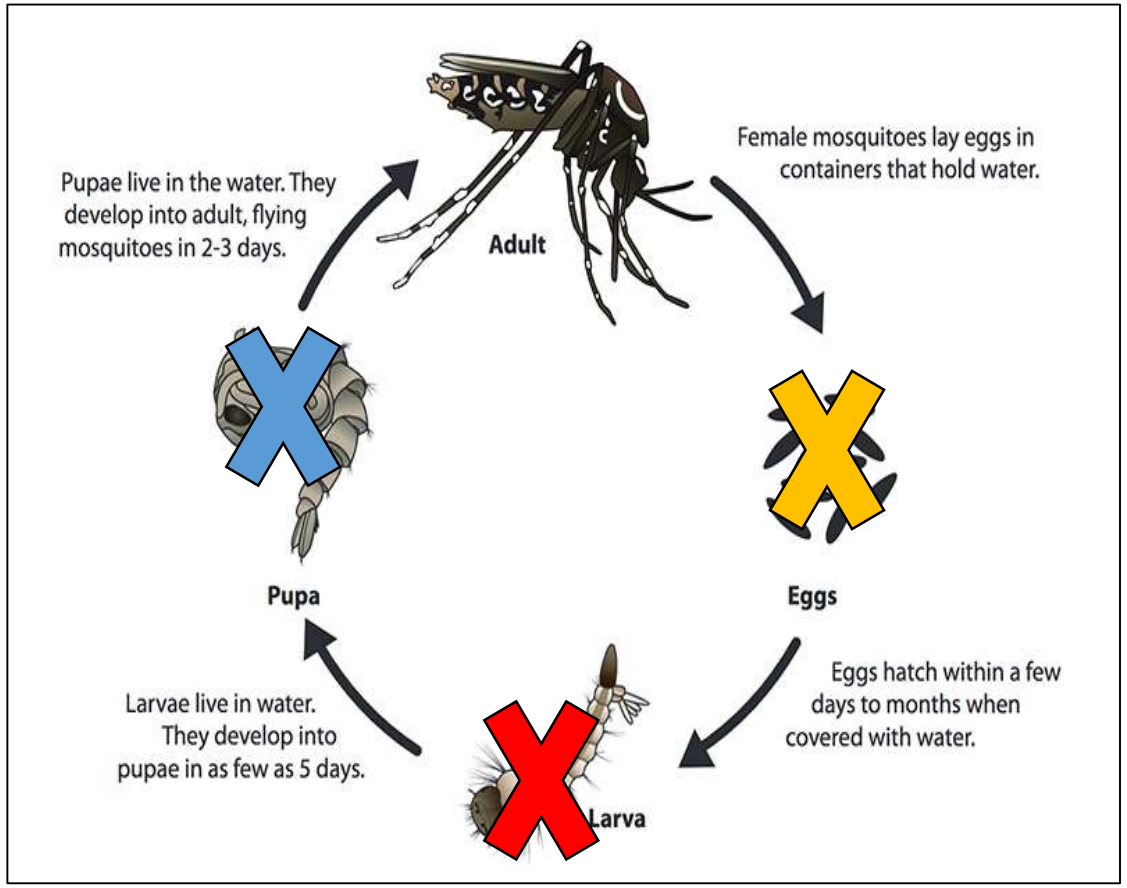
Integrated Vector Control Management – Use of autodessimination adulticide : in2care © traps

A lot of larvae!

It works very well!

No emergence in lab

Integrated Vector Control Management

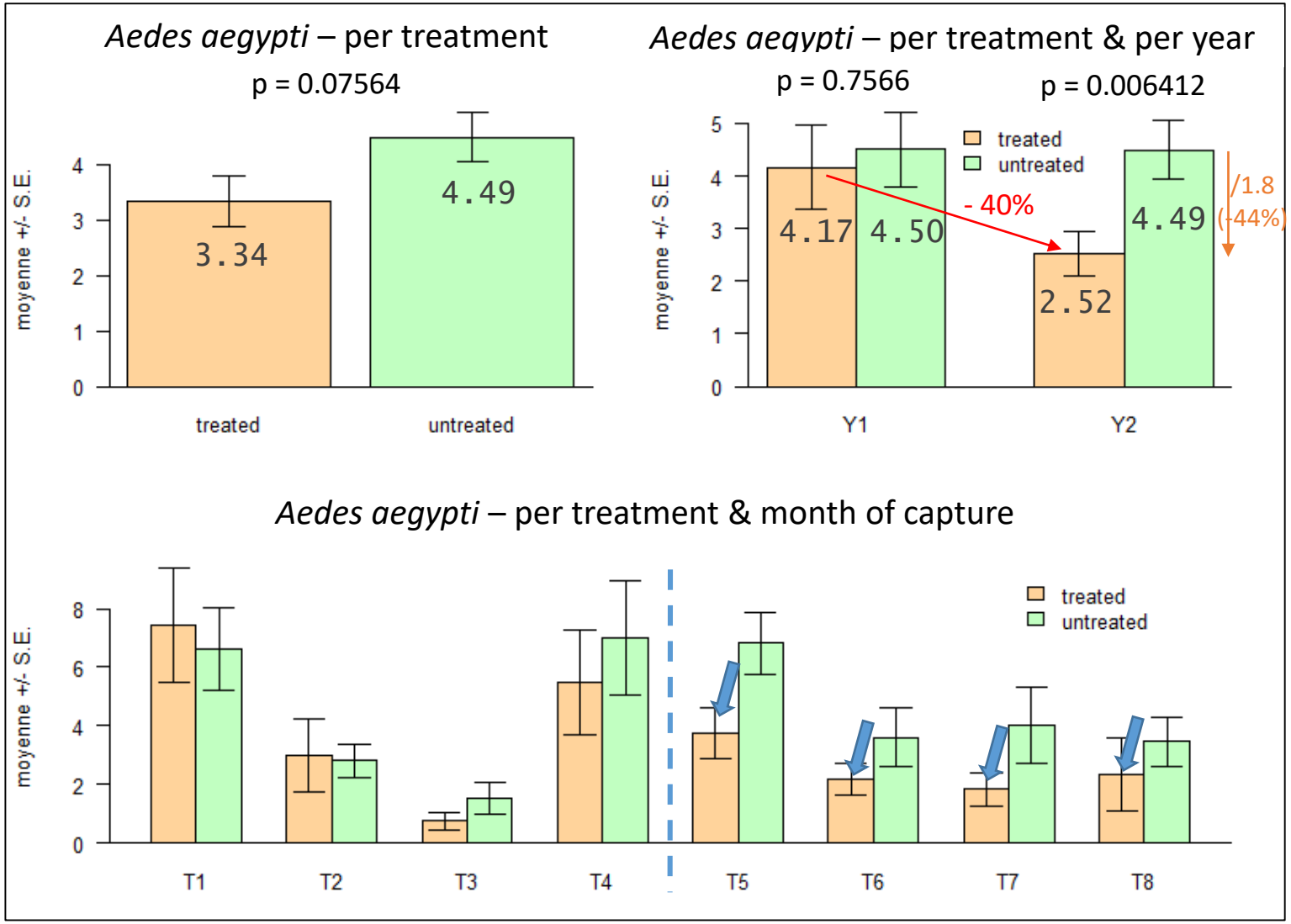


Use of *Bti*

Physical destruction

Pyriproxyfen autodissemination (in2care traps)

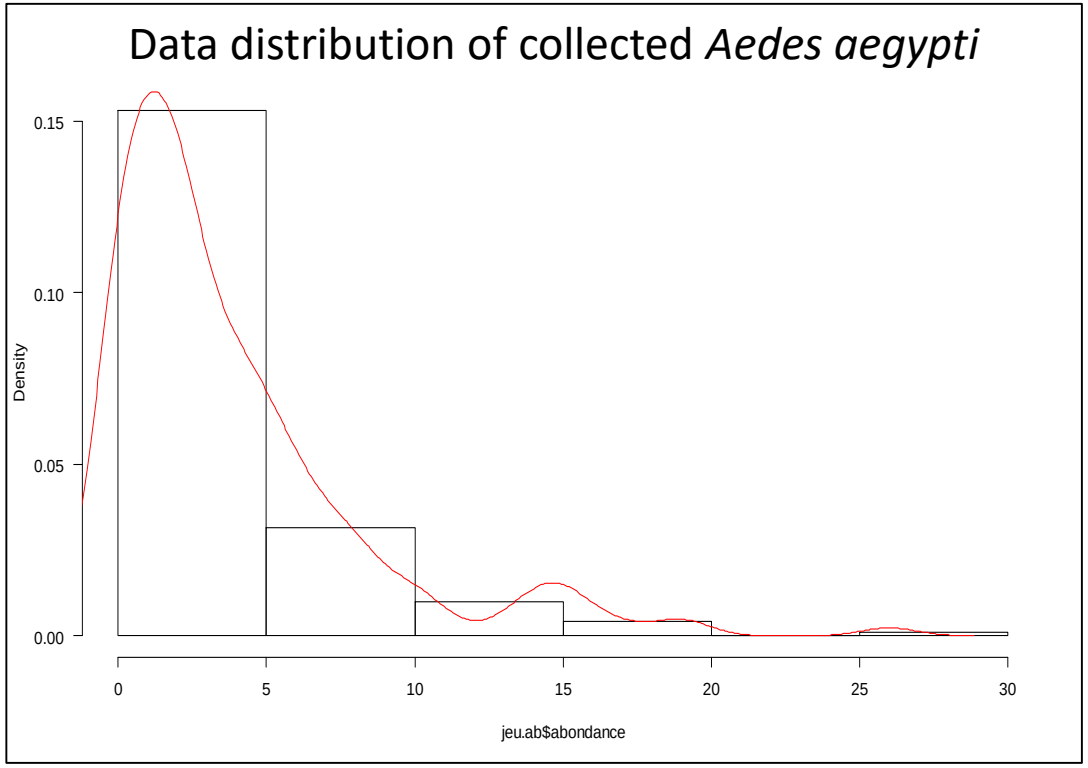
Integrated Vector Control Management – Results on *Aedes aegypti*



Treatment x year N.S.

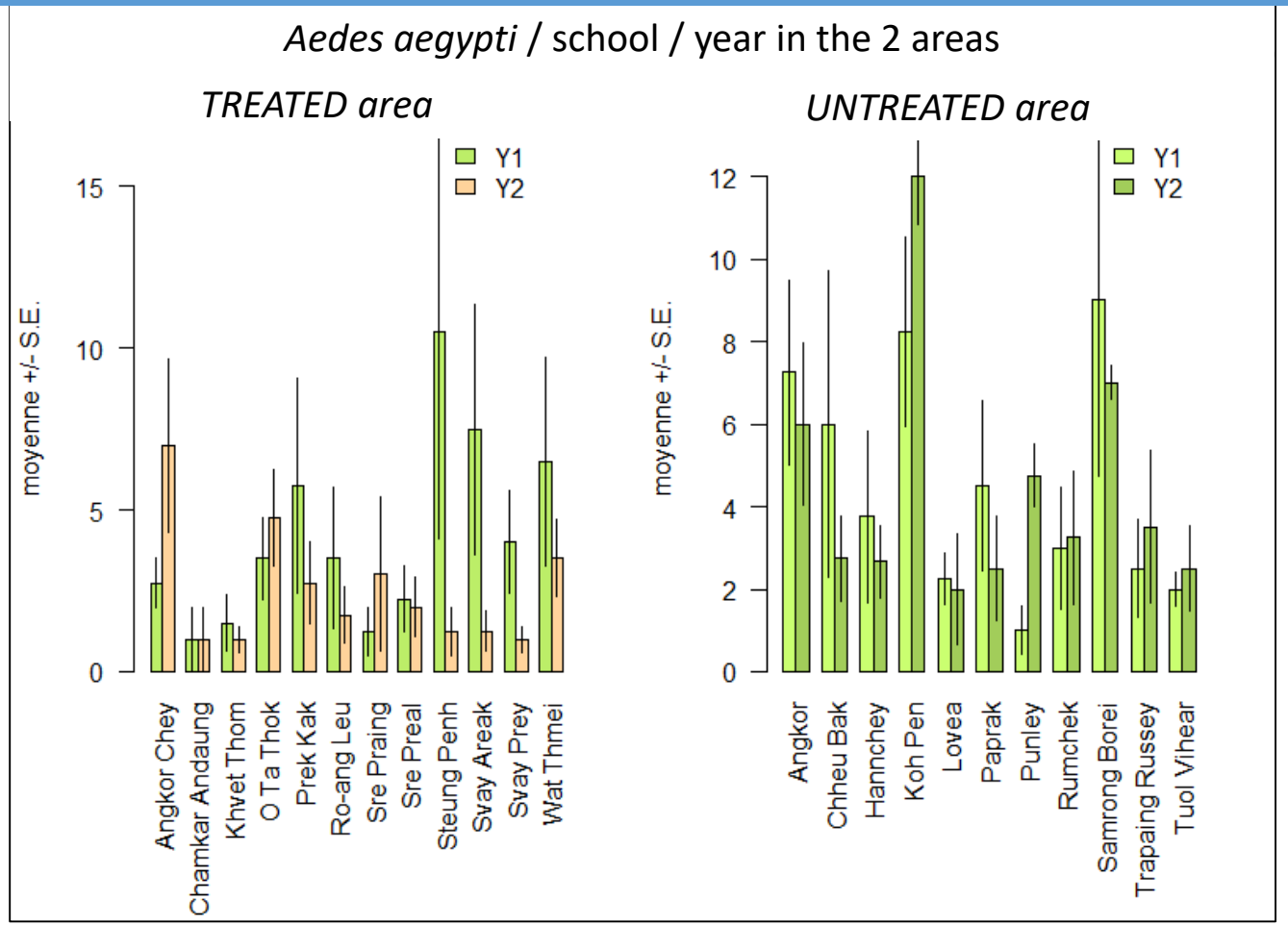
Integrated Vector Control Management – Results on *Aedes aegypti*

Data distribution of collected *Aedes aegypti*



- 0 – 26
- Data concentration : 0-3
- Data asymetry : tend to 0-1

Aedes aegypti / school / year in the 2 areas



- Heterogeneity of relative density data in schools

Integrated Vector Control Management – Mosquitoes, land use and climate change

With Vincent Herbreteau. Work realized by Sylvaine Jego

- **44 factors**:

  ✓ 18 environmental indicators (NDVI & Gao NDWI at day - 0, 5, 10, 15, 20, 30, 40, 50, 60)

  ✓ 13 spatial indicators (number of houses, hood perimeter, roads, nombre d'habitations / périmètre boisé / distance de routes)

  ✓ 6 school & demographic parameters (pagoda, trap, nb of children, school area, village population)

  ✓ 7 meteorological data (temperature, precipitation, R.H.)

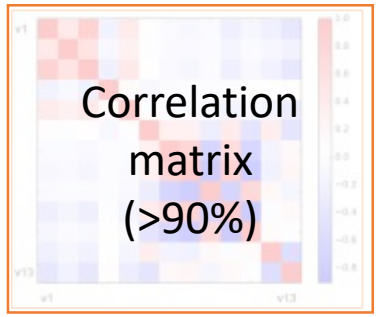
- **IVM + observation / intervention (Year1/2) : automatic inclusion**

Integrated Vector Control Management – Mosquitoes, land use and climate change

With Vincent Herbreteau. Work realized by Sylvaine Jego

44 factors

IVM x Year



Correlation matrix (>90%)

Fisher bivariate analysis with variables (10%)

- 8 variables for Shannon index
- 7 variables for Simpson index
- 11 variables for *Ae. aegypti*
- 9 variables for *Ae. albopictus*

Multivariate analysis on

- Biodiversity index
- Relative abundance of species
- Presence of species

Integrated Vector Control Management – Mosquitoes, land use and climate change

With Vincent Herbreteau. Work realized by Sylvaine Jego

Example of Biodiversity with Shannon index

- NDWI (day – 5) *
- Minimal temperature **
- Total precipitation *
- Relative humidy *
- Treatment ***
- Year 1/Year 2 *
- Relative Humidity* Year 1/Year2 ***

1 environmental indicator (satellite)
0 spatial indicator
0 school & demographic parameter
3 meteorological data
2 automatic inclusion (IVM + Year)

Example with *Aedes aegypti*

- Presence of small river ***
- Flooding area *
- Relative humidity **
- Max temperature ***
- Month of collect ***
- Treatment **

0 environmental indicator (satellite)
2 spatial indicators
0 school & demographic parameters
2 meteorological data
2 automatic inclusion (IVM + Year)

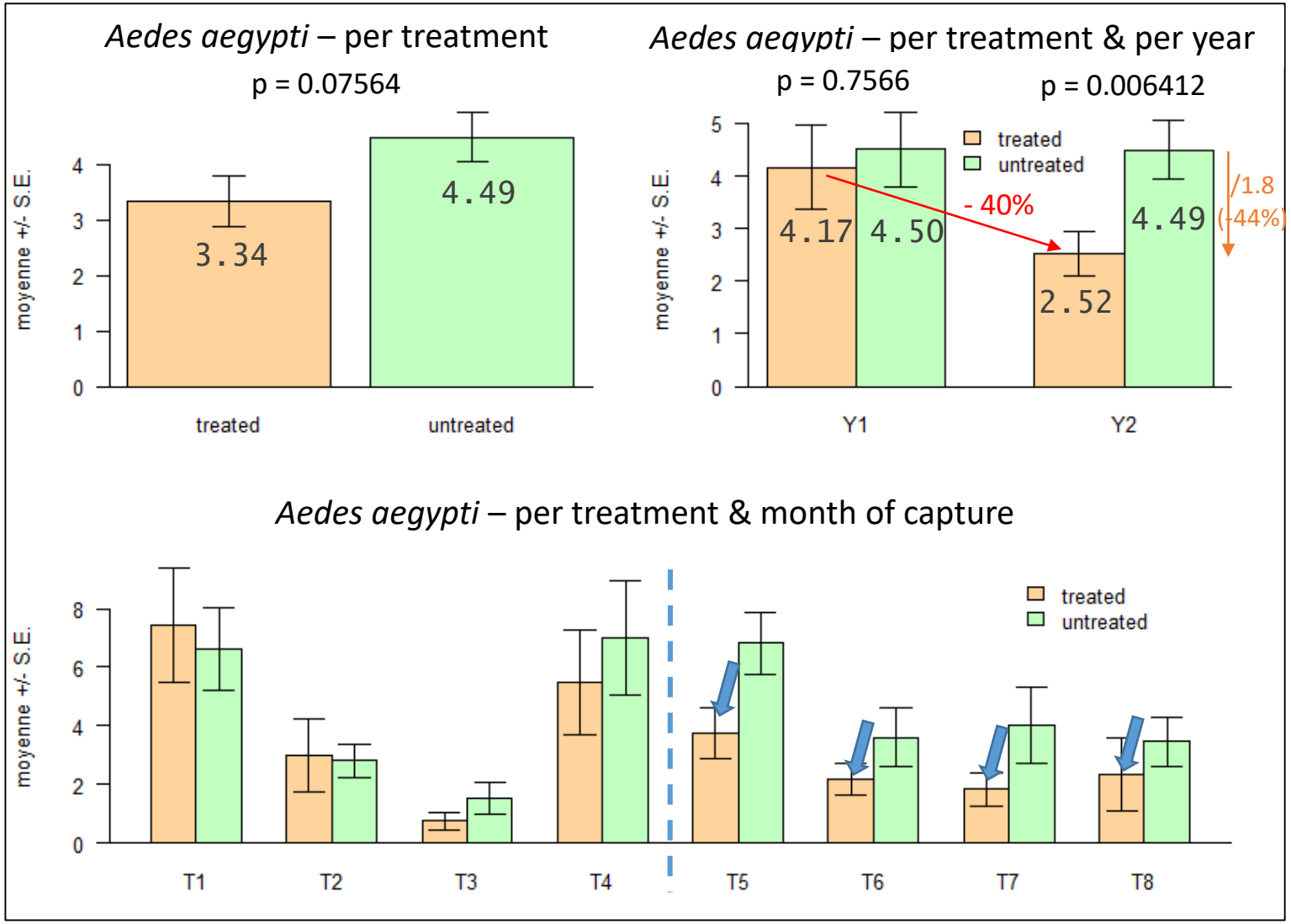
Example with *Aedes albopictus*

- NDVI (day – 20) ***
- Forest perimeter **
- Number of school children ***
- Wind speed *
- Year 1/Year 2 ***

1 environmental indicator (satellite)
1 spatial indicator
1 school & demographic parameter
1 meteorological data
1 automatic inclusion (IVM + Year)

No treatment effect on the Biodiversity

Integrated Vector Control Management – Results on *Aedes aegypti*



Treatment x year N.S.

Integrated Vector Control Management – Small breeding sites in schools

Determination of small breeding sites after vector control intervention

Inventory in August 2018
(5 months after the main treatment)

Positive breeding sites	
Plastic cup	**42%**
Jar	20%
Plastic bottle	**11%**
Rice box	**7%**
Tree holes	6%
Ground water	6%
Can	**4%**
Flower pot	2%
Small pool	2%

In orange and red, human-made breeding sites (88%).
In **bold red**, trash directly done by children and teachers (**64%**).

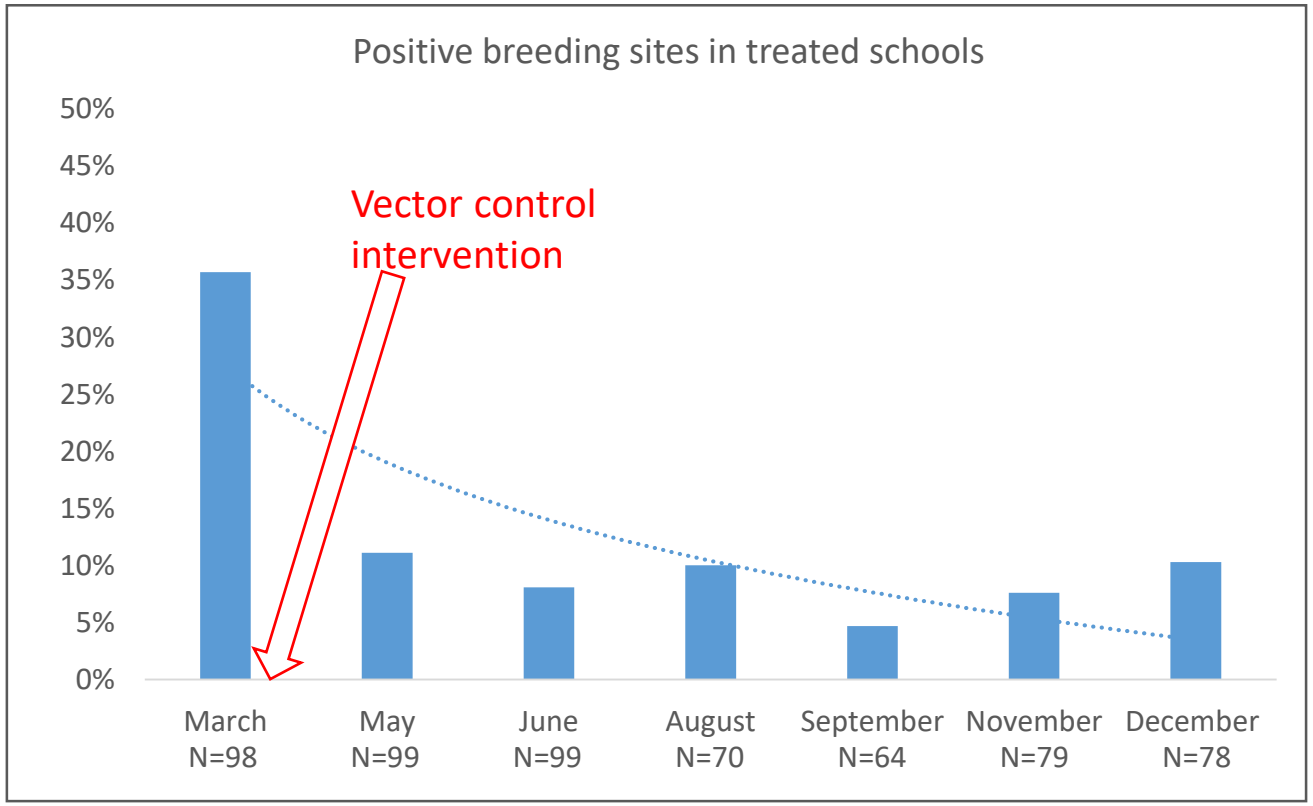
Small breeding sites with water

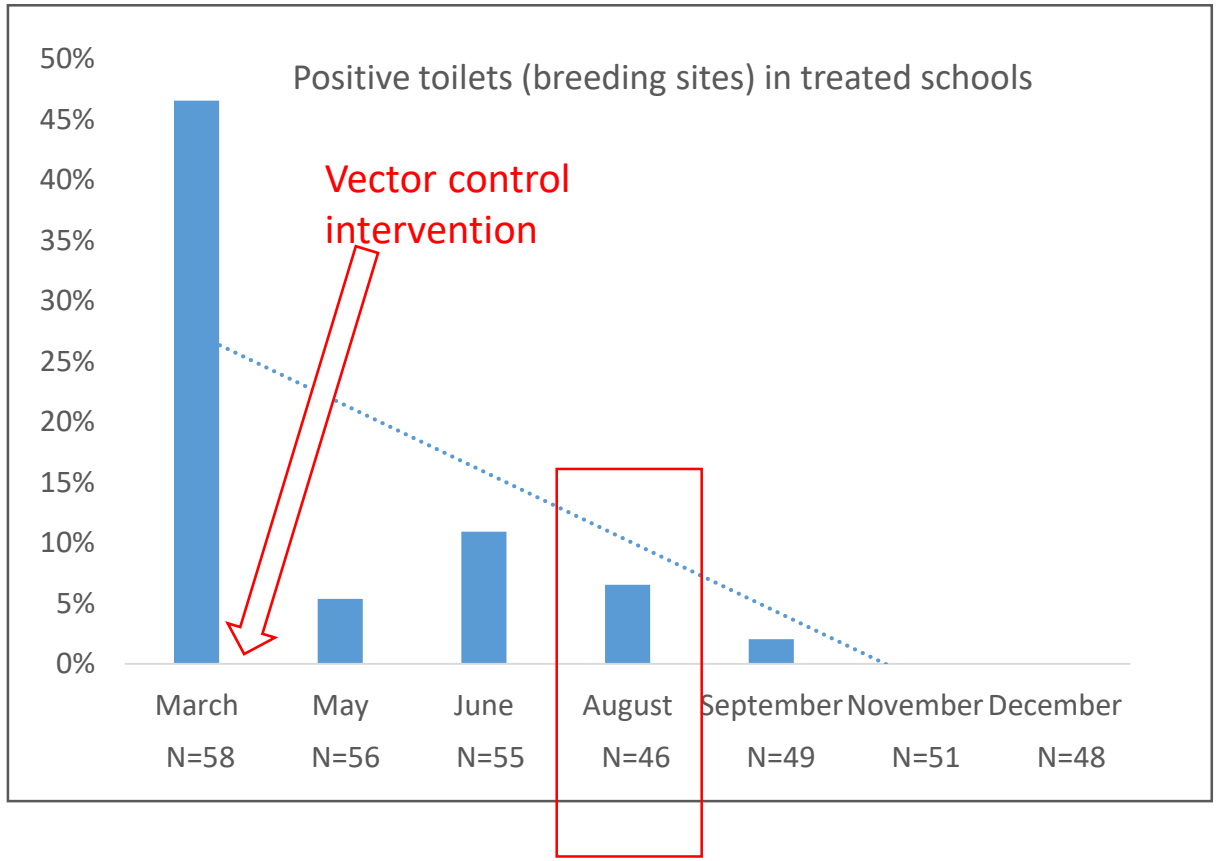
- 422 in untreated schools
- 38.4 / untreated schools
- 3.5 % positive

- 404 in treated sites
- 33.7 / treated sites
- **7.6 % positive**

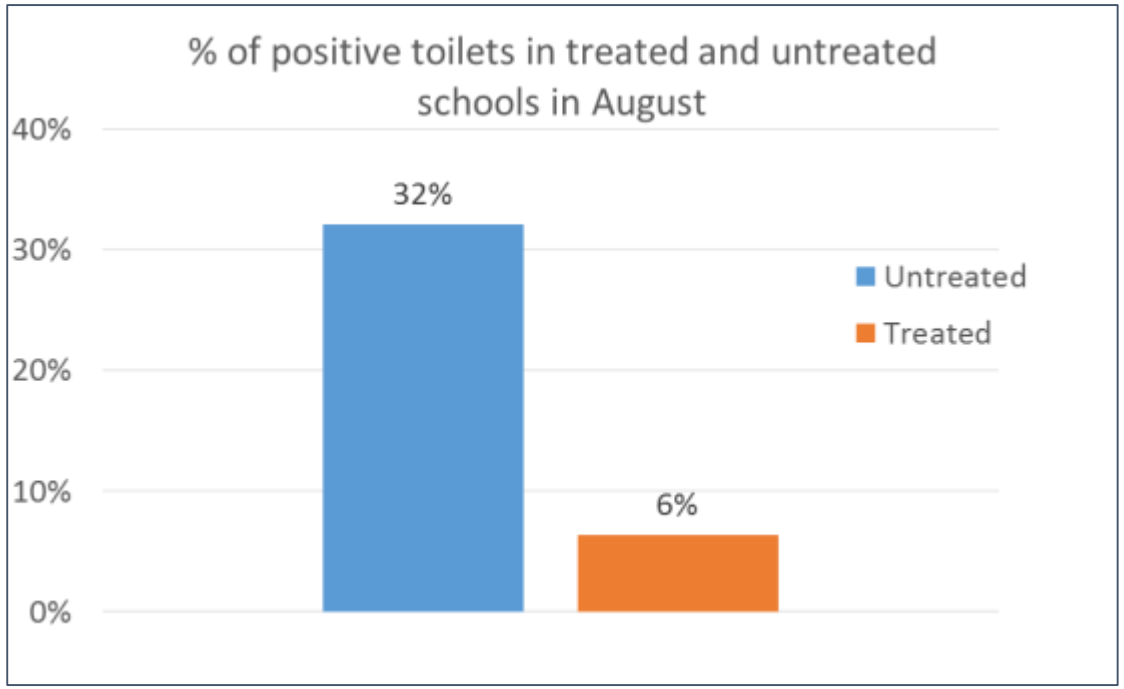
Seems that plastic prevention didn't work…

Integrated Vector Control Management – breeding sites in schools

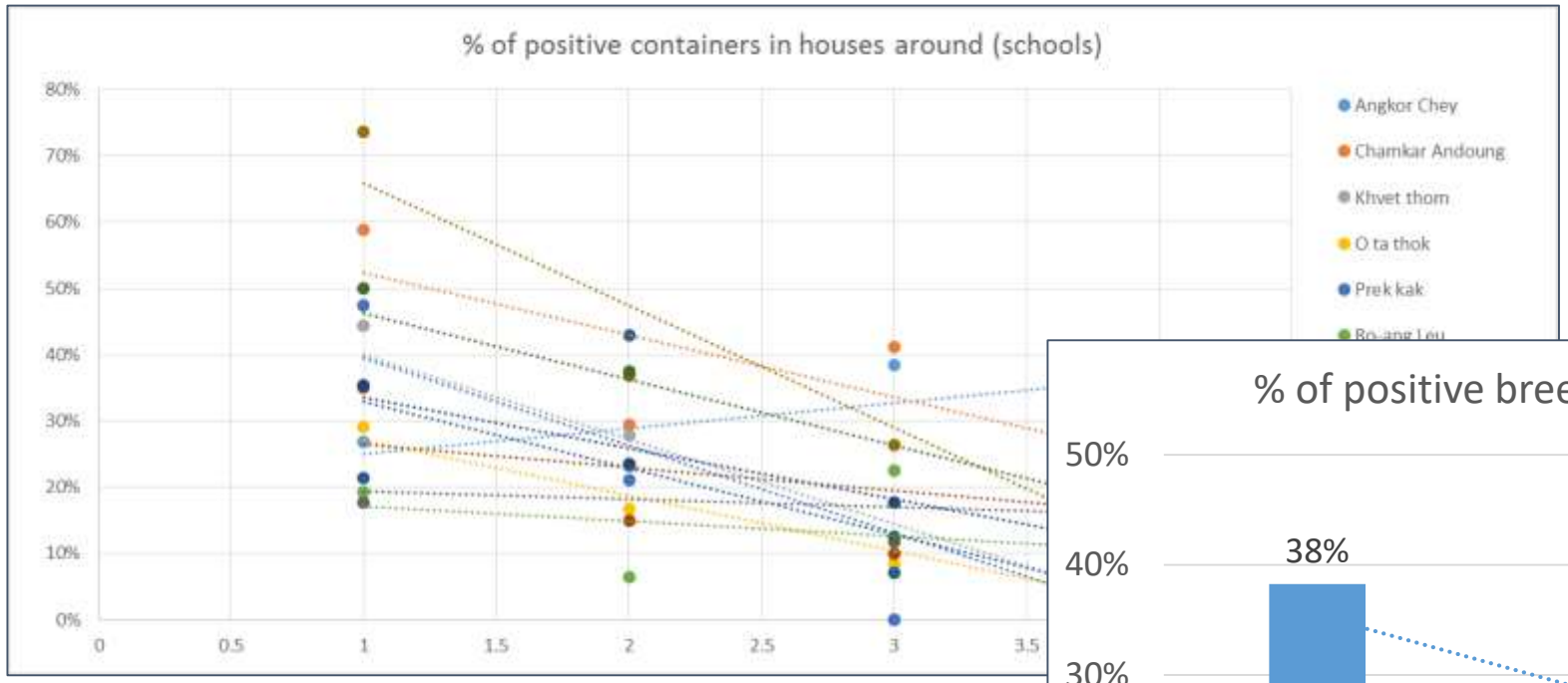




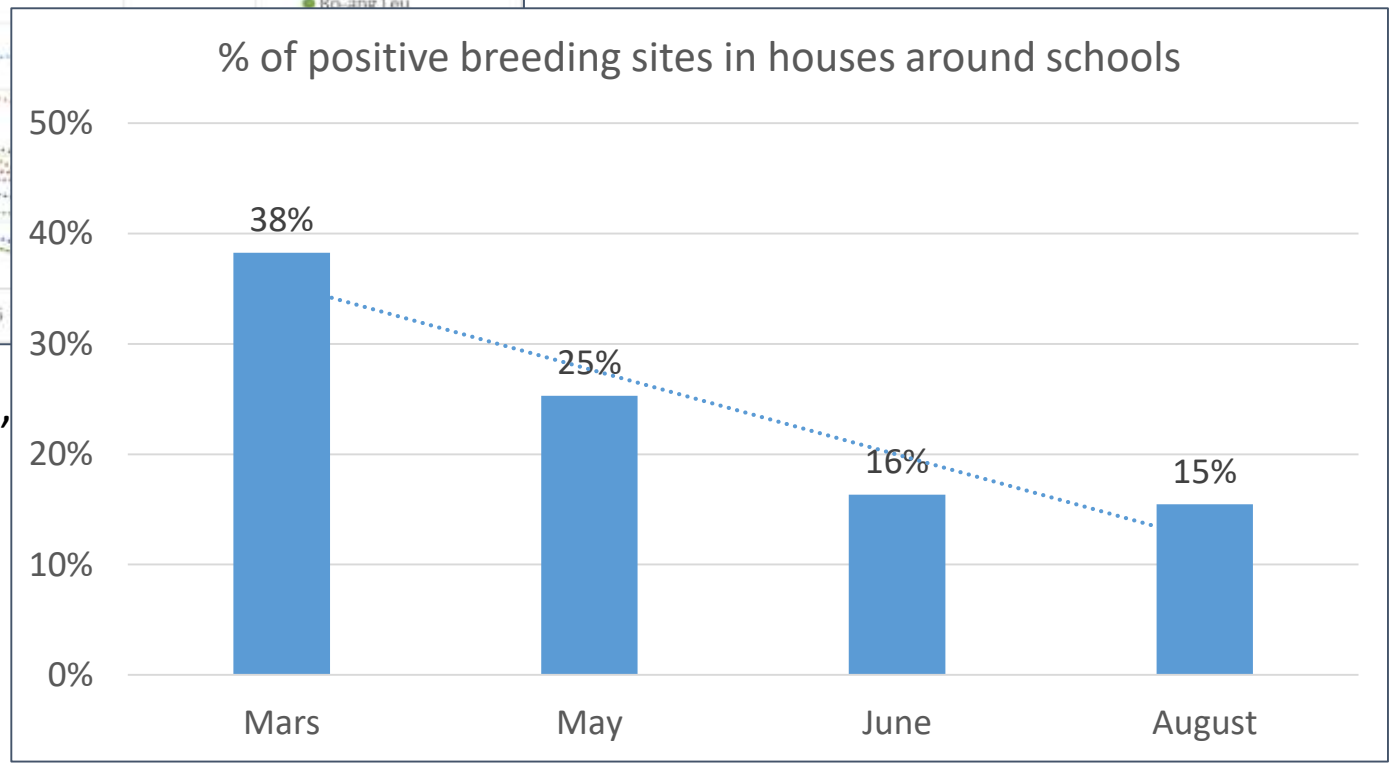
Integrated Vector Control Management – breeding sites in schools



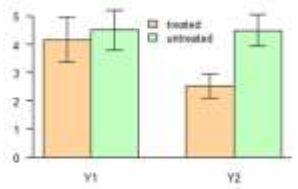
Integrated Vector Control Management – houses around schools



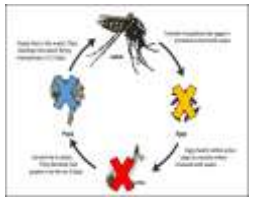
In all houses around schools (except for one school), decrease of positive containers in treated schools



Integrated Vector Control Management – Main results on Medical Entomology



- 44% of *Aedes aegypti* in treated areas vs.
Same number in untreated schools



No impact of integrated vector management on
Shannon and Jaccard index (2 Biodiversity index)

Decrease of *Aedes aegypti* in school toilets in
treated schools (hypothesis: *Bti* effect)

Water reservoir in toilets in schools are the most positive
and productive breeding sites for Dengue vectors

Integrated Vector Control Management – Knowledge and transmission

POSTERS

Creation of 2 posters
Distribution of poster 1 in every classroom
Explanation to students and teachers
Distribution of poster 2 in every school

BREEDING SITES

Destruction of breeding sites
Involvement of children

In2Care TRAPS

Presentation of the traps
Explanation in the field

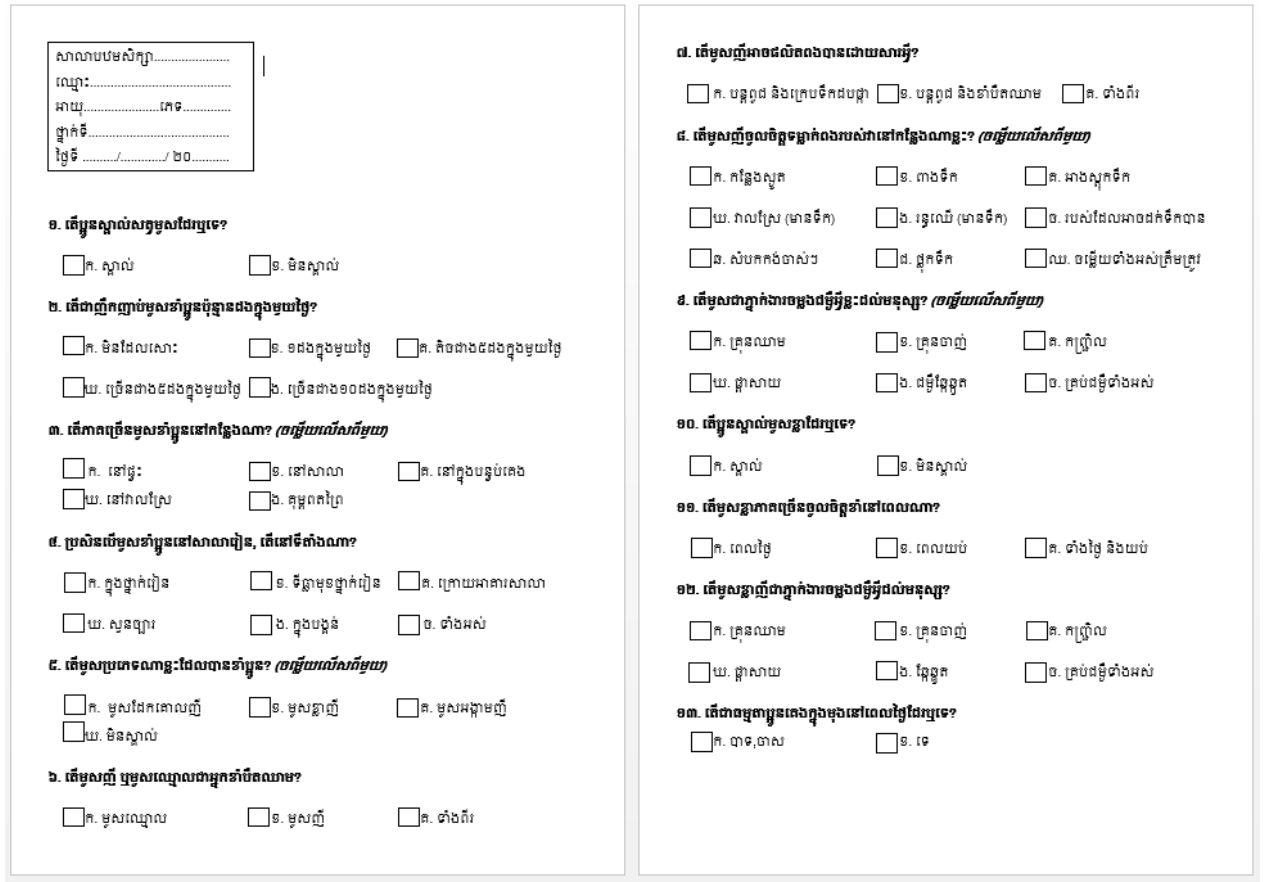
INVENTORY

Demonstration of presence of larvae to children

Integrated Vector Control Management – Knowledge and transmisison - Reminder

Integrated Vector Control Management – Knowledge and transmission - Reminder

Integrated Vector Control Management – Knowledge and transmission - Questionaries



សាលាបឋមសិក្សា.....
ឈ្មោះ:.....
អាយុ.....ភេទ.....
ថ្នាក់ទី.....
ថ្ងៃទី ...../...../ ២០.....

១. តើប្អូនស្គាល់សត្វមូសដែរឬទេ?

☐ក. ស្គាល់ ☐ខ. មិនស្គាល់

២. តើជាញឹកញាប់មូសទាំប្អូនប៉ុន្មានដងក្នុងមួយថ្ងៃ?

☐ក. មិនដែលសោះ ☐ខ. ១ដងក្នុងមួយថ្ងៃ ☐គ. តិចជាង៥ដងក្នុងមួយថ្ងៃ
☐ឃ. ច្រើនជាង៥ដងក្នុងមួយថ្ងៃ ☐ង. ច្រើនជាង១០ដងក្នុងមួយថ្ងៃ

៣. តើភាគច្រើនមូសទាំប្អូននៅកន្លែងណា? *(ចម្លើយលើសពីមួយ)*

☐ក. នៅផ្ទះ: ☐ខ. នៅសាលា ☐គ. នៅក្នុងបន្ទប់គេង
☐ឃ. នៅវាលស្រែ ☐ង. តុម្ពពនព្រៃ

៤. ប្រសិនបើមូសទាំប្អូននៅសាលារៀន, តើនៅទីតាំងណា?

☐ក. ក្នុងថ្នាក់រៀន ☐ខ. ទីធ្លាមុខថ្នាក់រៀន ☐គ. ក្រោយអាគារសាលា
☐ឃ. សួនច្បារ ☐ង. ក្នុងបង្គន ☐ច. ចាំងអស់

៥. តើមូសប្រភេទណាខ្លះដែលបានទាំប្អូន? *(ចម្លើយលើសពីមួយ)*

☐ក. មូសដែកគោលញី ☐ខ. មូសខ្លាញី ☐គ. មូសអង្កាមញី
☐ឃ. មិនស្គាល់

៦. តើមូសញី ឬមូសឈ្មោលជាអ្នកទាំបឹតឈាម?

☐ក. មូសឈ្មោល ☐ខ. មូសញី ☐គ. ចាំងពីរ

៧. តើមូសញីអាចផលិតពងបានដោយសារអ្វី?

☐ក. បន្តពូជ និងក្របខ័ណ្ឌបង្ហា ☐ខ. បន្តពូជ និងទាំបឹតឈាម ☐គ. ចាំងពីរ

៨. តើមូសញីចូលចិត្តទម្លាក់ពងរបស់វានៅកន្លែងណាខ្លះ:? *(ចម្លើយលើសពីមួយ)*

☐ក. កន្លែងស្ងួត ☐ខ. ៣ងទឹក ☐គ. ងាងស្អុកទឹក
☐ឃ. វាលស្រែ (មានទឹក) ☐ង. ទ្វេលើ (មានទឹក) ☐ច. របស់ដែលអាចដក់ទឹកបាន
☐ឆ. សំបកកង់ចាស់ៗ ☐ជ. ផ្លុកទឹក ☐ឈ. ចម្លើយចាំងអស់ត្រឹមត្រូវ

៩. តើមូសជាភ្នាក់ងារចម្លងជម្ងឺអ្វីខ្លះដល់មនុស្ស? *(ចម្លើយលើសពីមួយ)*

☐ក. គ្រុនឈាម ☐ខ. គ្រុនចាញ់ ☐គ. ក្បាលិ
☐ឃ. ផ្លាសាយ ☐ង. ជម្ងឺឆ្កែឆ្កួត ☐ច. គ្រប់ជម្ងឺចាំងអស់

១០. តើប្អូនស្គាល់មូសខ្លាដែរឬទេ?

☐ក. ស្គាល់ ☐ខ. មិនស្គាល់

១១. តើមូសខ្លាភាគច្រើនចូលចិត្តទាំនៅពេលណា?

☐ក. ពេលថ្ងៃ ☐ខ. ពេលយប់ ☐គ. ចាំងថ្ងៃ និងយប់

១២. តើមូសខ្លាញីជាភ្នាក់ងារចម្លងជម្ងឺអ្វីដល់មនុស្ស?

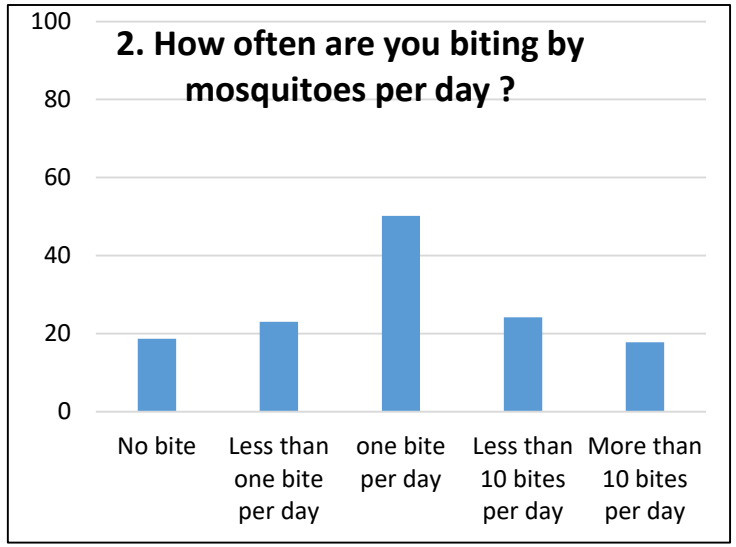
☐ក. គ្រុនឈាម ☐ខ. គ្រុនចាញ់ ☐គ. ក្បាលិ
☐ឃ. ផ្លាសាយ ☐ង. ឆ្កែឆ្កួត ☐ច. គ្រប់ជម្ងឺចាំងអស់

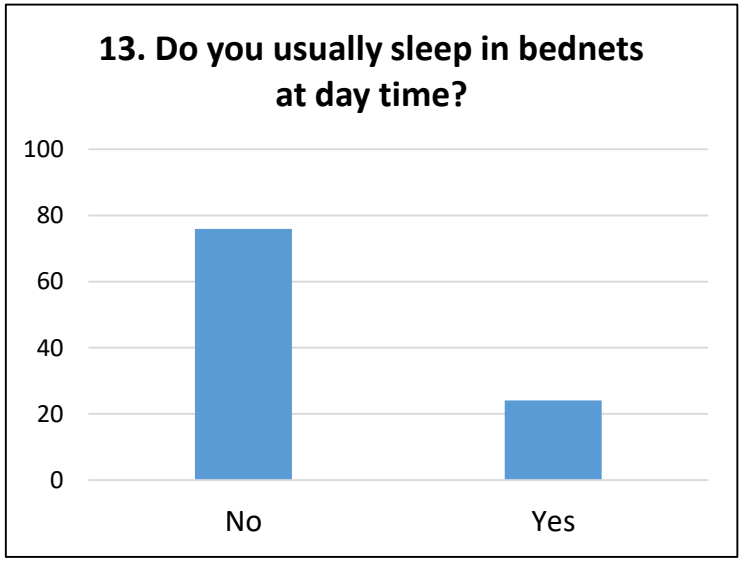
១៣. តើជាធម្មតាប្អូនគេងក្នុងមុងនៅពេលថ្ងៃដែរឬទេ?

☐ក. បាទ,ចាស ☐ខ. ទេ

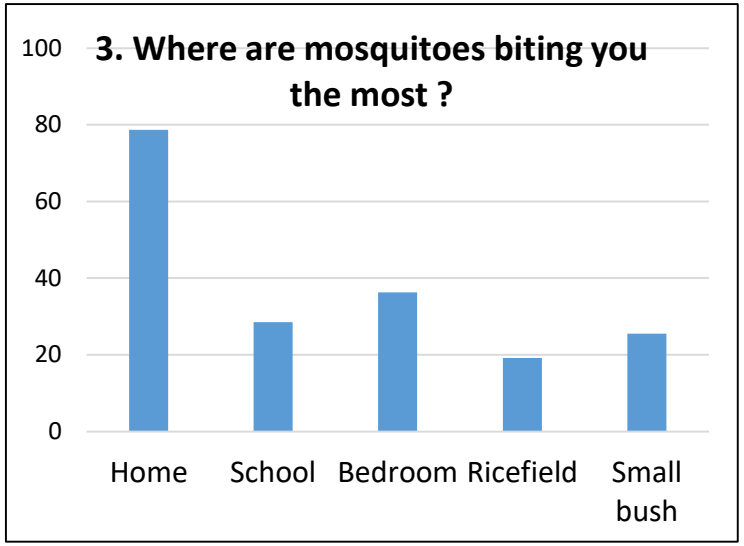
- 30 questionaries x 24 schools x 3 years
- 8-10 years old children
- 23 questions

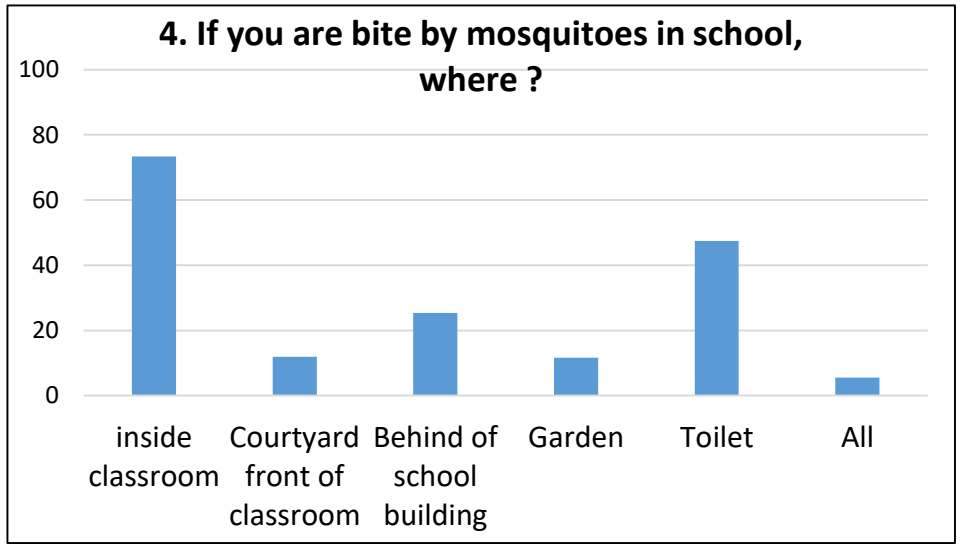
Integrated Vector Control Management – Knowledge and transmission - Questionaries



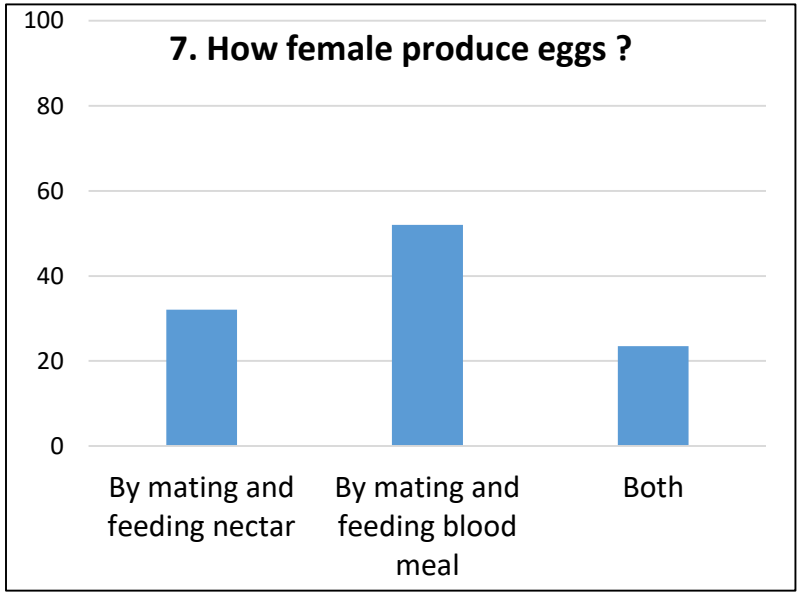


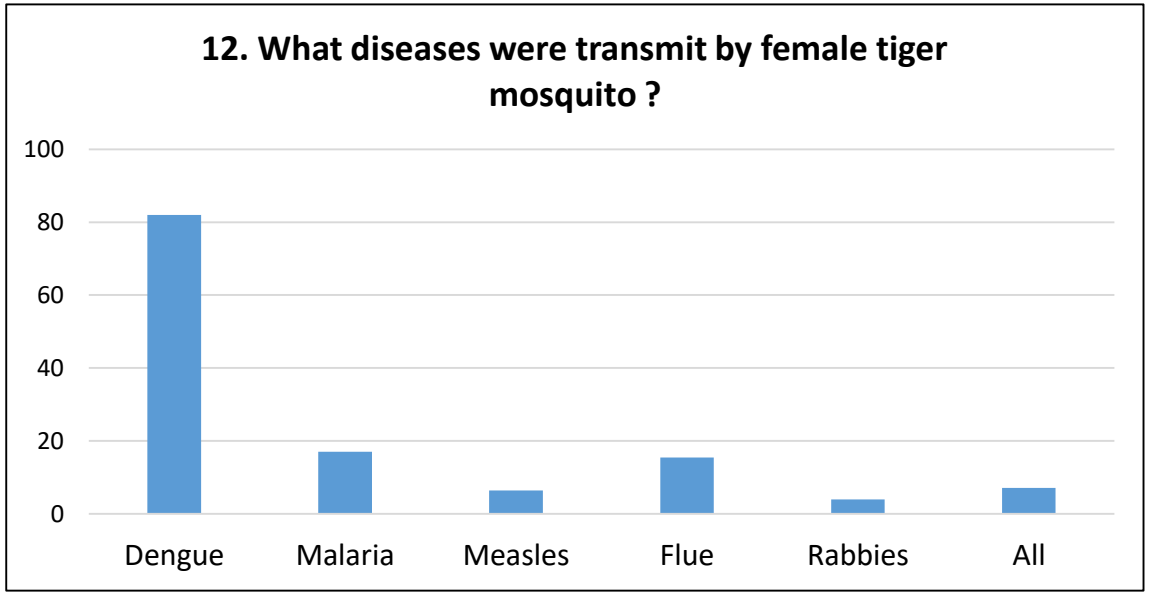
Integrated Vector Control Management – Knowledge and transmission - Questionaries





Integrated Vector Control Management – Knowledge and transmission - Questionaries





- 1st year : data entry OK (720)
- 2nd year : data entry OK (720)
- 3rd year: data in February (720)
- Remain to do : data analysis (2160) (ITM Antwerp)

Integrated Vector Control Management – Meeting with directors

- Presentation of Ecomore II project in Khmer (by Sony)

- Ministry of Health
- Ministry of Education

- All the 24 Directors were present (and sometimes the deputy director)
- Questions (around 2 hours)

- Distribution of books & stickers

Integrated Vector Control Management – Scientific objectives

RELATED QUESTIONS

- Is the density of *Aedes aegypti* the same in the 2 clusters before treatment ? **YES**
- What is the mosquito composition species ? **> 69 species, presence of vector species…**
- What are the breeding sites in/around schools ? **mainly toilets in the schools**
- Are *Aedes aegypti* resistant to insecticides ? **YES** **Deltamethrin, permethrin, temephos (Abate)**

  No resistance to *Bti*

MAIN QUESTION

- Do the IVM decrease the population of *Aedes aegypti*? **YES**

Integrated Vector Control Management – Milestones

Milestonename / Short description	1st S.C.	2nd S.C.	3rd S.C.
Senior entomologist PhD deployment	✓	✓	✓
Initial inventory of breeding sites in schools and destruction with participation of scholar	WORK IN PROGRESS	✓	✓
Result of insecticide sensitivity and selection of products for the control of vectors	WORK IN PROGRESS	✓	✓
Implementation of adult mosquitoes control	COMING SOON	✓	✓
Installation of auto-dissemination system around schools	COMING SOON	✓	✓
Kits for COMBI ready to be distributed	WORK IN PROGRESS	WORK IN PROGRESS	✓

Acknowledgements

- School directors and teachers
- Medical Entomology team : Sony, Kalyan, Moeun, Kimhuor
- Yves (for support & coordination)

Questions and Discussion