

Arbovirus vectors surveillance in Senegal and Nigeria

Dr. Babacar Diouf

Institut Pasteur de Dakar
Department of Medical Zoology

20/08/2024



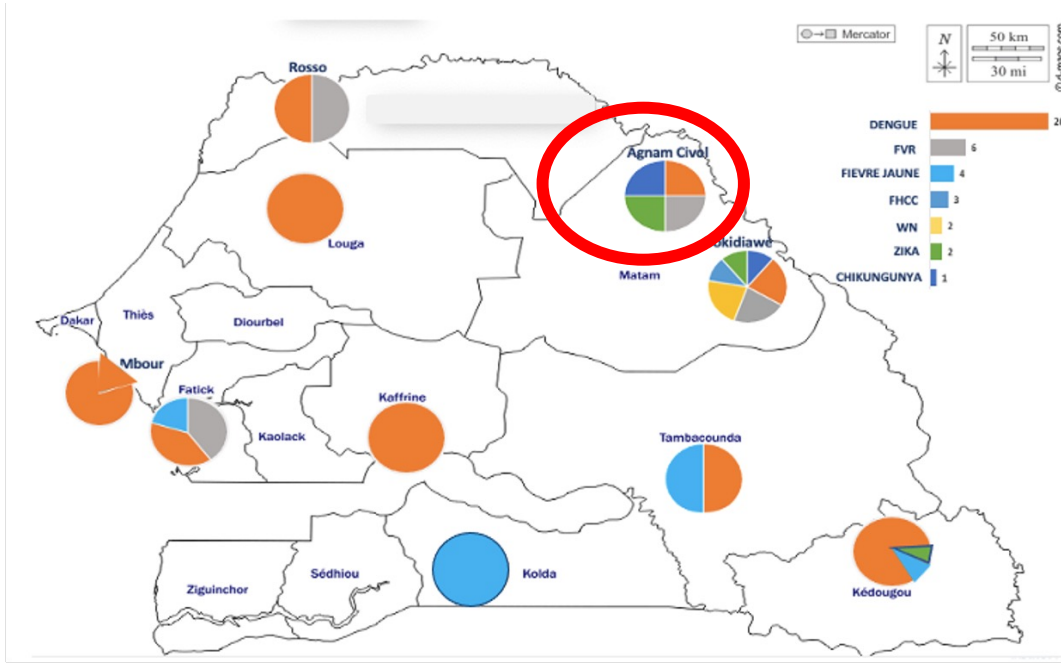
Background

- The West African region is facing an increase in outbreaks of arboviruses such as dengue, chikungunya, and Zika, necessitating proactive surveillance of mosquito vectors.
- The climatic conditions in West Africa, particularly prolonged rainy seasons, are conducive to the proliferation of vector mosquitoes, increasing the risk of arbovirus transmission.
- Arboviruses pose a significant threat to public health, with serious consequences for vulnerable populations, justifying the implementation of an effective surveillance program.
- A surveillance program would enable early detection of vectors and a rapid response to prevent the spread of arboviruses, contributing to regional health security.

Objectives

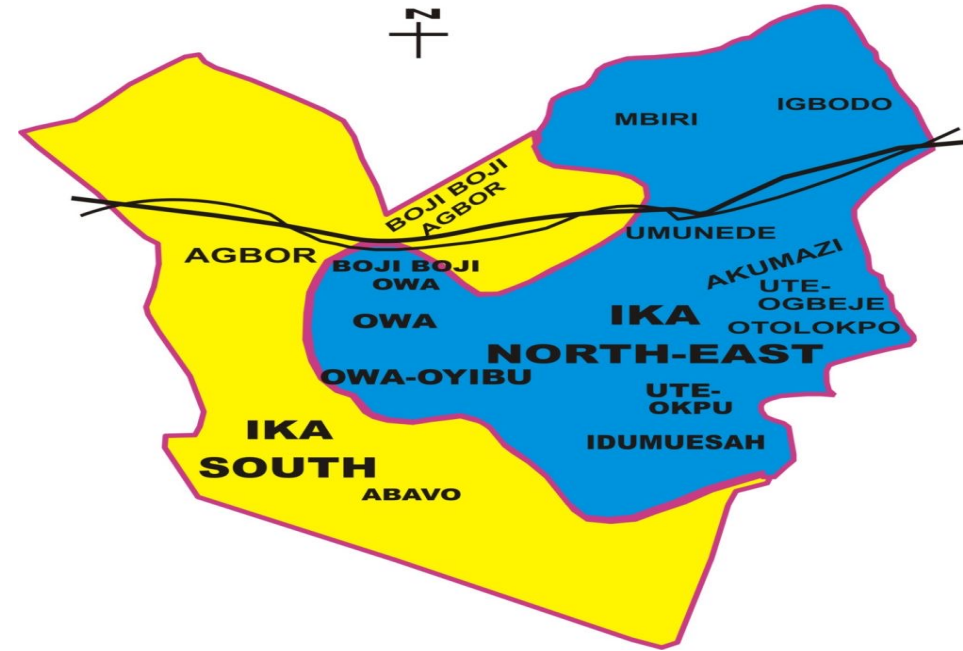
- 🎯 To census arbovirus vectors and to establish the typology of their breeding sites
- 🎯 To monitor the spatial and temporal fluctuations of entomological indicators
- 🎯 To study the ecological behavior of vector populations
- 🎯 To monitor the circulation of arboviruses in vectors
- 🎯 To train local agents at pilot sites capable of conducting vector surveillance

Study area



Matam is located in the north of Senegal, where outbreaks of vector-borne diseases such as Dengue and Rift Valley Fever are endemic and have been repeatedly reported

Two communities: Agnam Thioday and Nabdji



Delta State is one of the states where recent outbreak of Yellow fever occurred in Nigeria with cases from Ika North-East Local Government Area.

Five communities : Ute-Okpu, Owa Oyibo, Umunede. Idumesah, and Otolokpo

Main activities

- ✓ Adult & larvae sampling
- ✓ Egg collections

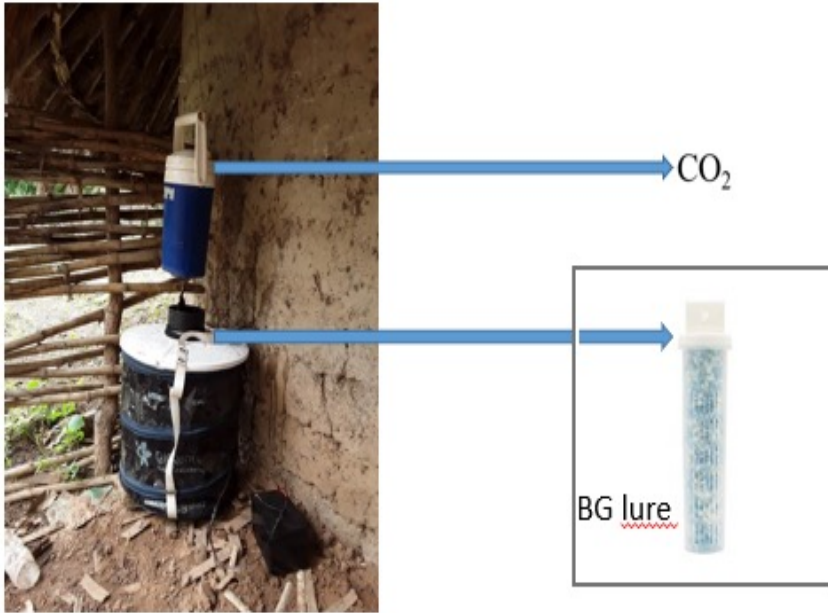
Senegal

- Four field sampling in 2023 (September - December)
- Two in 2024 (May and July)

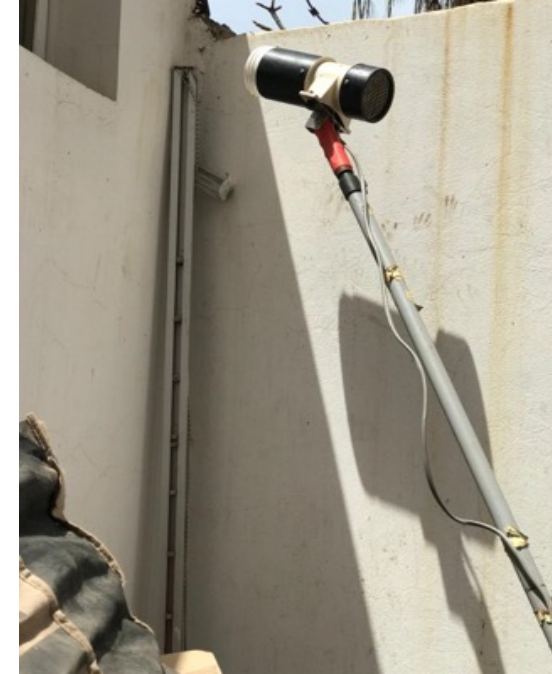
Nigeria

- Four field sampling in 2023 (July - October)
- One in April 2024

Adult sampling



- Host siking mosquitoes were collected during 2 consecutive days with a recovery of mosquitoes collected every hour using two BG-Sentinel traps per house, with one set indoors and one set outdoors.



- Adult mosquitoes resting indoors and outdoors were collected for 10 minutes in the morning from 40 houses using a Prokopack Aspirator

Mosquito processing



Morphological identification keys

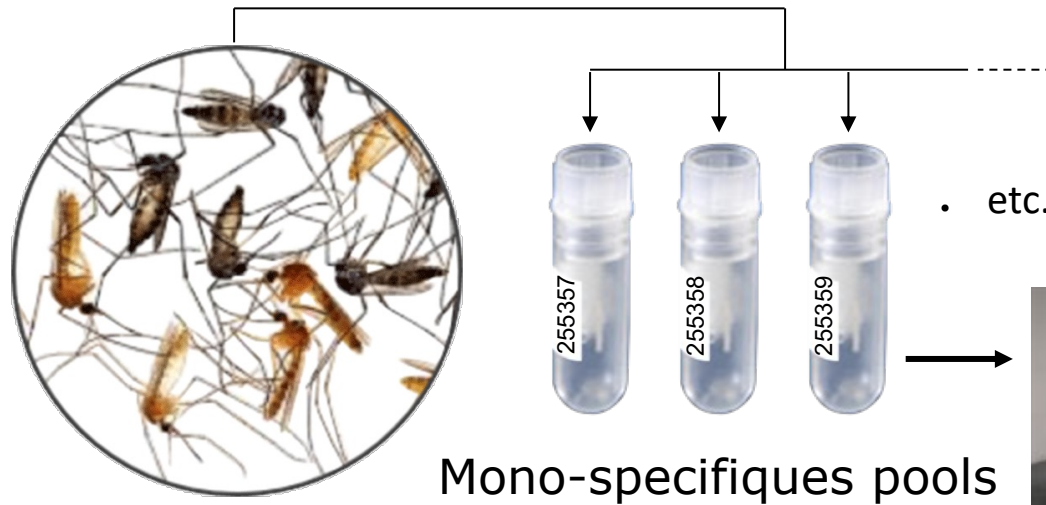
Edwards, 1941

Ferrara *et al.*, 1984

Huang et Ward, 1986

Diagne *et al.*, 1994

Aedes spp.
.....
species plurinae



Grouped into pools based on the site,
method, species, physiological state, and sex

RT-PCR & ELISA Tests

Larval sampling, Senegal



Larvae and pupae sampling in water storage or discarded containers

Larvae and pupae were sampled in all water storage or discarded containers and all artificial containers likely to contain water found indoors and outdoors (in the peridomestic environment) at 40 georeferenced houses. The collected larvae were transferred to labeled bottles and transported to the insectarium. Immature mosquitoes sampled from each type of water container were reared to adults.

Eggs sampling, Senegal

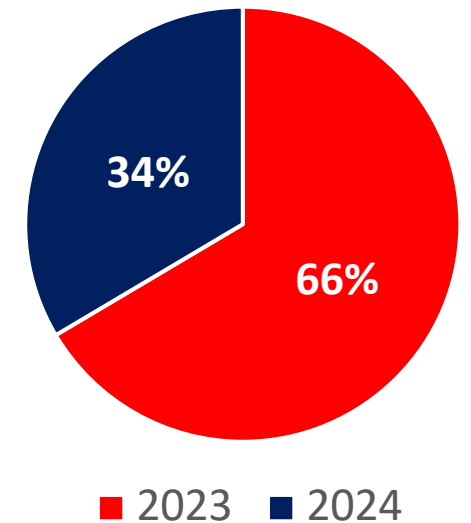


40 ovitraps were randomly placed in selected and georeferenced houses and surveyed weekly by community agents.

The collected eggs were counted, hatched, and the emerging adults identified, with egg densities assessed over time and space.

Specific composition of the collected mosquitoes, Nigeria

Species	Communities					Totals	Percentage (%)
	Ute-Okpu	Owa Oyibo	Umunede	Idumesah	Otolokpo		
<i>Aedes aegypti</i>	45	16	1	10	65	137	66
<i>Culex quinquefasciatus</i>	18	0	3	3	18	42	34
Total	63	16	4	13	83	179	



A total of 179 mosquitoes were collected from the study area belonging to two genera and two species with *Aedes aegypti* found more in the study area

Specific composition of the collected mosquitoes, Senegal

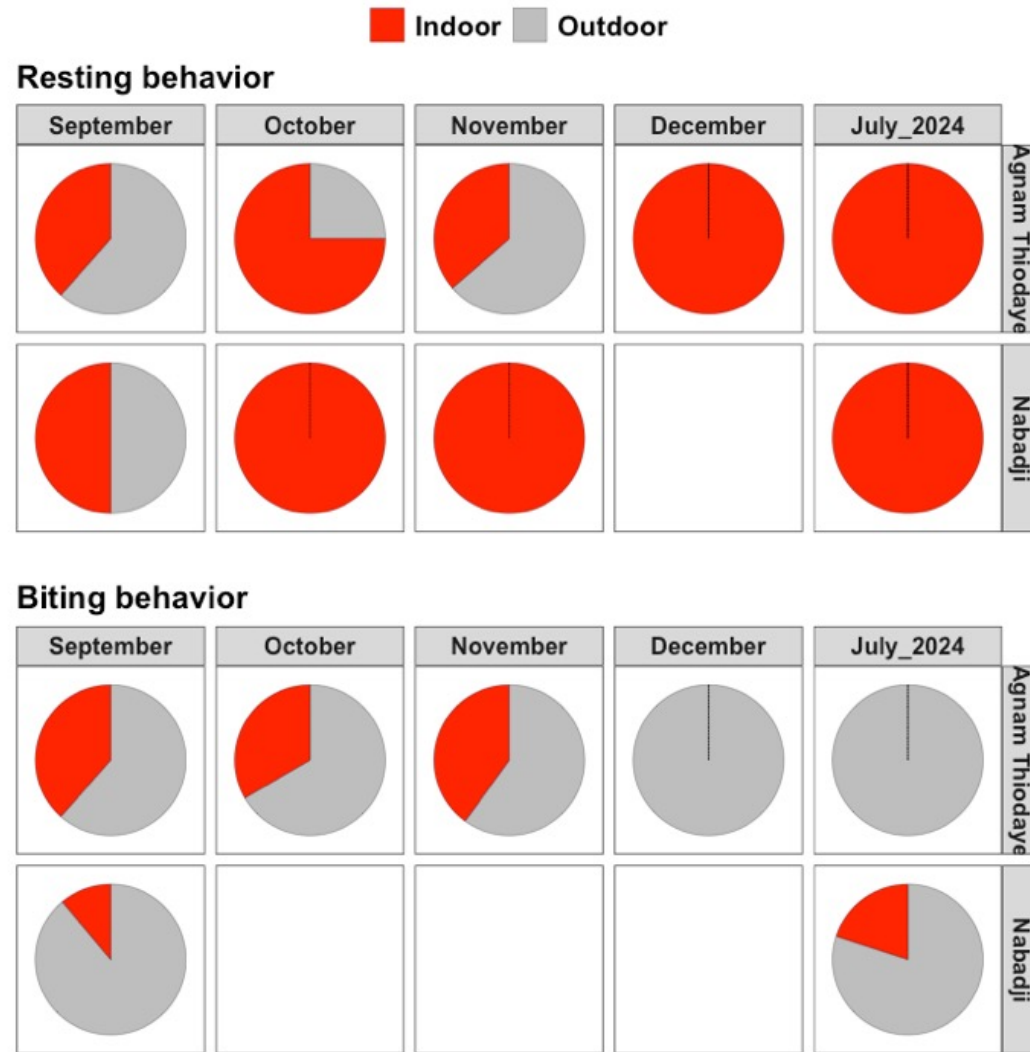
Species	Method		Total
	Aspiration	BG+CO2	
<i>Aedes aegypti</i>	63	83	146
<i>Aedes fowleri</i>	1		1
<i>Aedes vittatus</i>		32	32
<i>Anopheles domicola</i>	1		1
<i>Anopheles freetownensis</i>		2	2
<i>Anopheles gambiae</i>	39	27	66
<i>Anopheles pharoensis</i>		39	39
<i>Anopheles rufipes</i>	5	11	16
<i>Culex bitaeniorhynchus</i>		4	4
<i>Culex cinereus</i>		2	2
<i>Culex decens</i>	9	1	10
<i>Culex neavei</i>	12		12
<i>Culex nubulosis</i>		1	1
<i>Culex perfuscus</i>	1		1
<i>Culex poicilipes</i>		2	2
<i>Culex quinquefasciatus</i>	4948	14448	19396
<i>Culex theileri</i>	1		1
<i>Culex tritaeniorhynchus</i>		3	3
Total	5080	14656	19735

A total of 19735 adult mosquitoes belonging to 3 genera and 18 species was collected by all sampling methods.

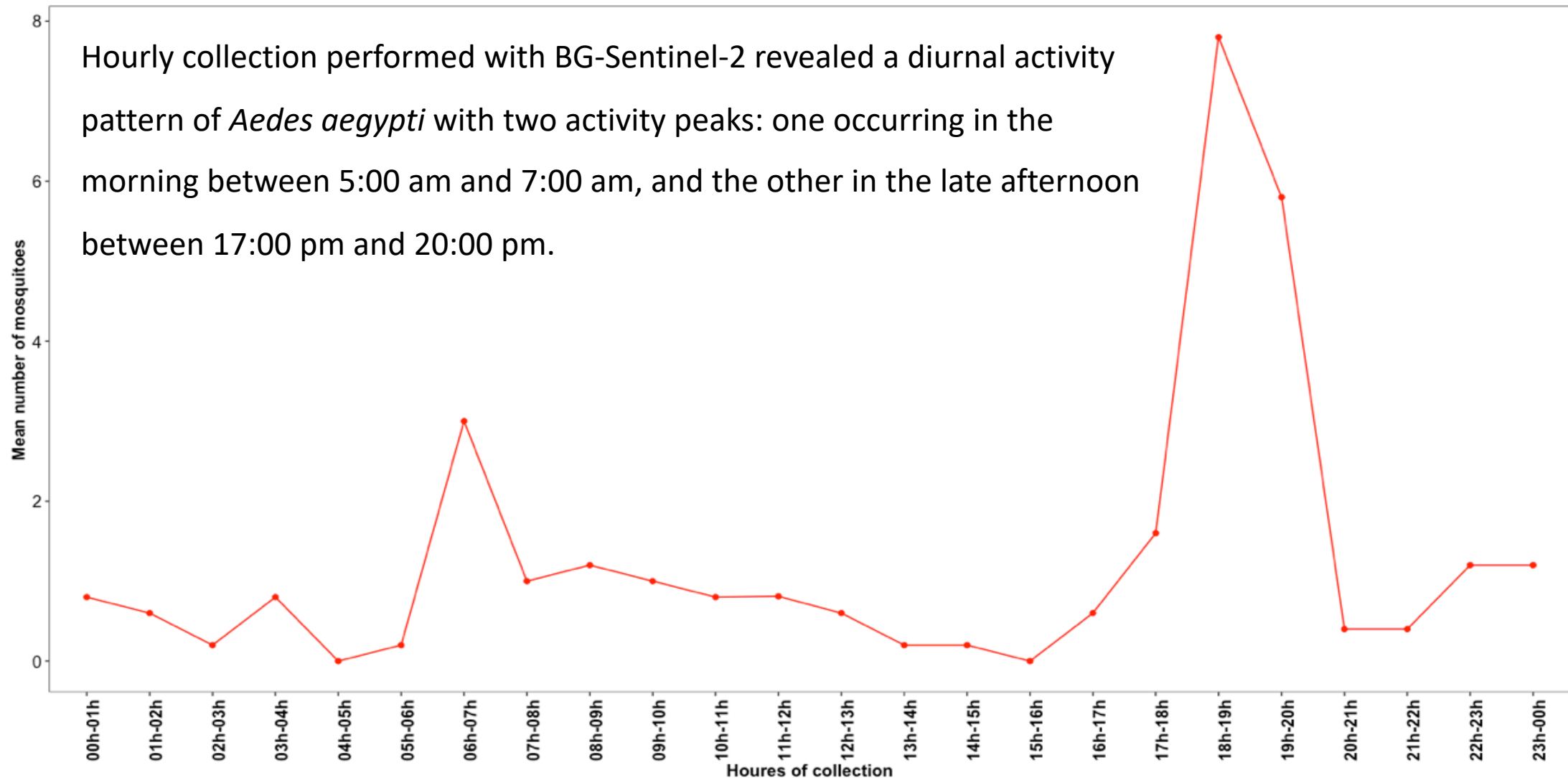
Culex quinquefasciatus was the most common species and many potential vectors of arboviruses were detected.

Resting and biting behavior of *Aedes aegypti*, Senegal

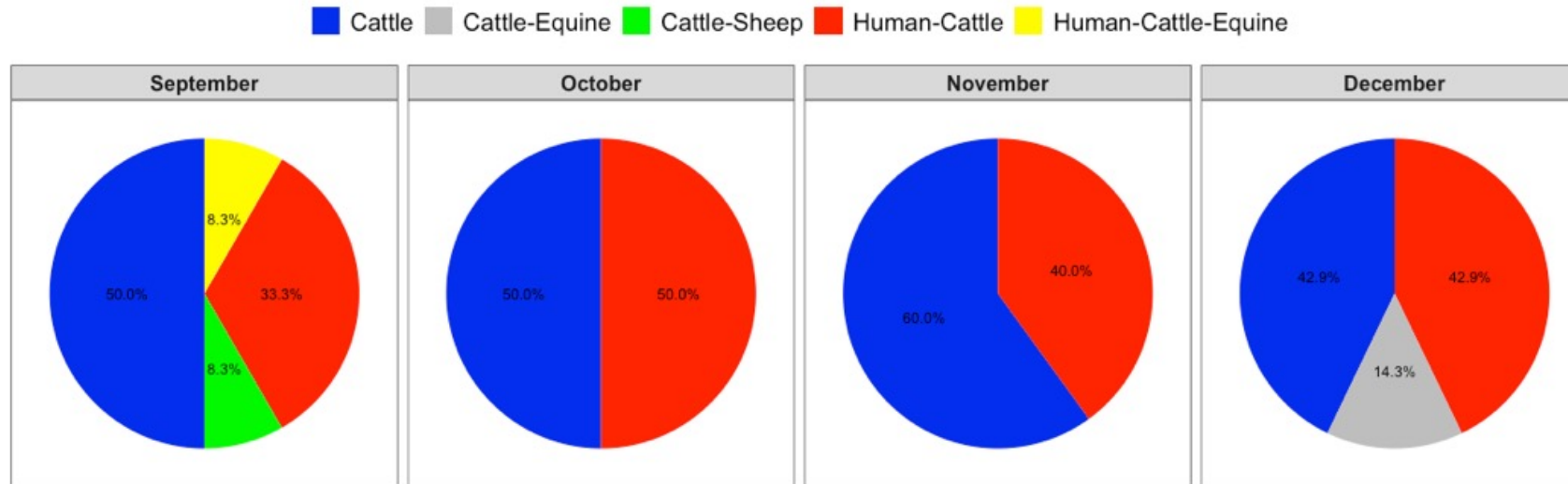
Aedes aegypti was collected host-seeking mostly outdoor and rested indoor in both localities.



Biting rate dynamics of *Aedes aegypti*, Senegal



Blood feeding patterns of *Aedes aegypti* , Senegal



Analysis of the origin of blood meals showed that mosquitoes fed on humans, sheep, cattle and equine. More than half of the blood meals identified involved at least one human host, indicating a real risk of transmission in the area. The proportion of blood meals originating from domestic animals indicates that they may play an important role in transmission, and should therefore be the subject of further seroprevalence studies.

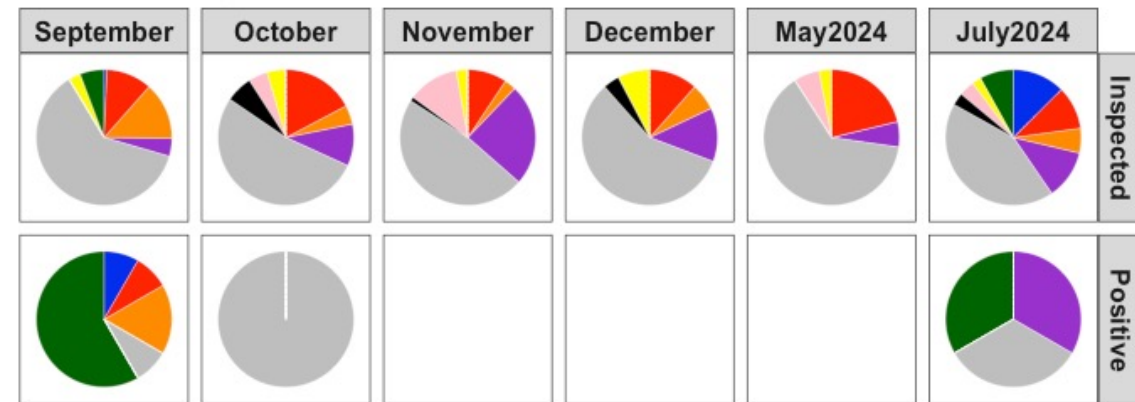
Typology of infested containers , Senegal

A total of 1025 containers were inspected from September 2023 to July 2024 in the two localities.

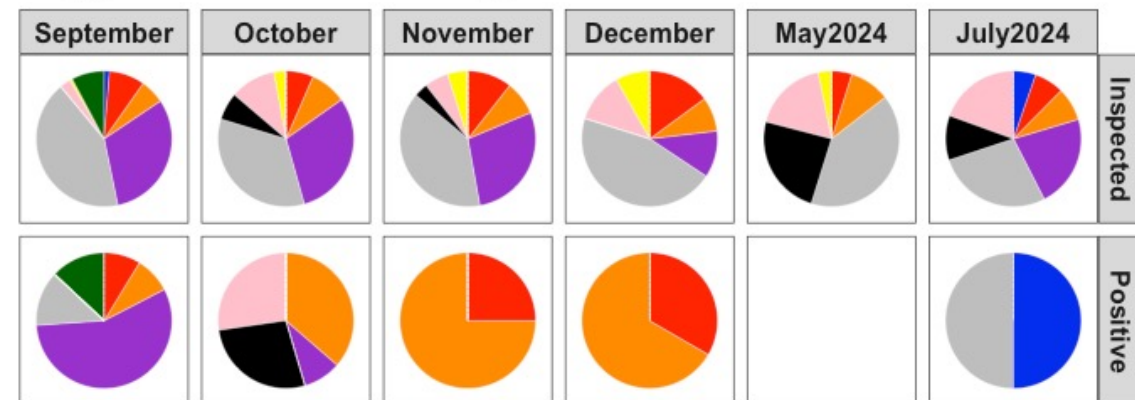
The typology of *Aedes aegypti* breeding sites was similar in both localities visited and was in majority water storage containers used for drinking or household activities mostly



Nabadji



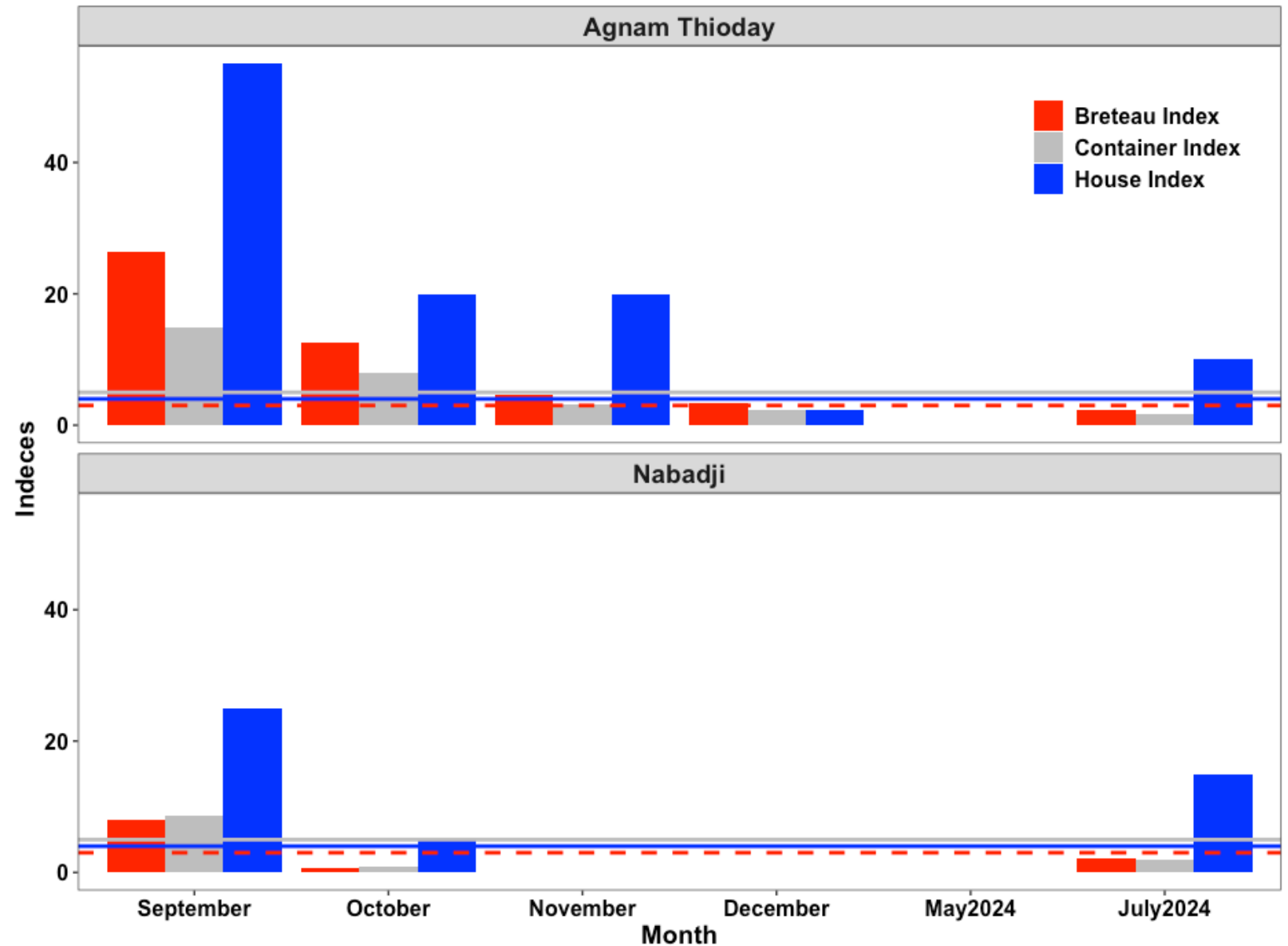
Agnam Thiodaye



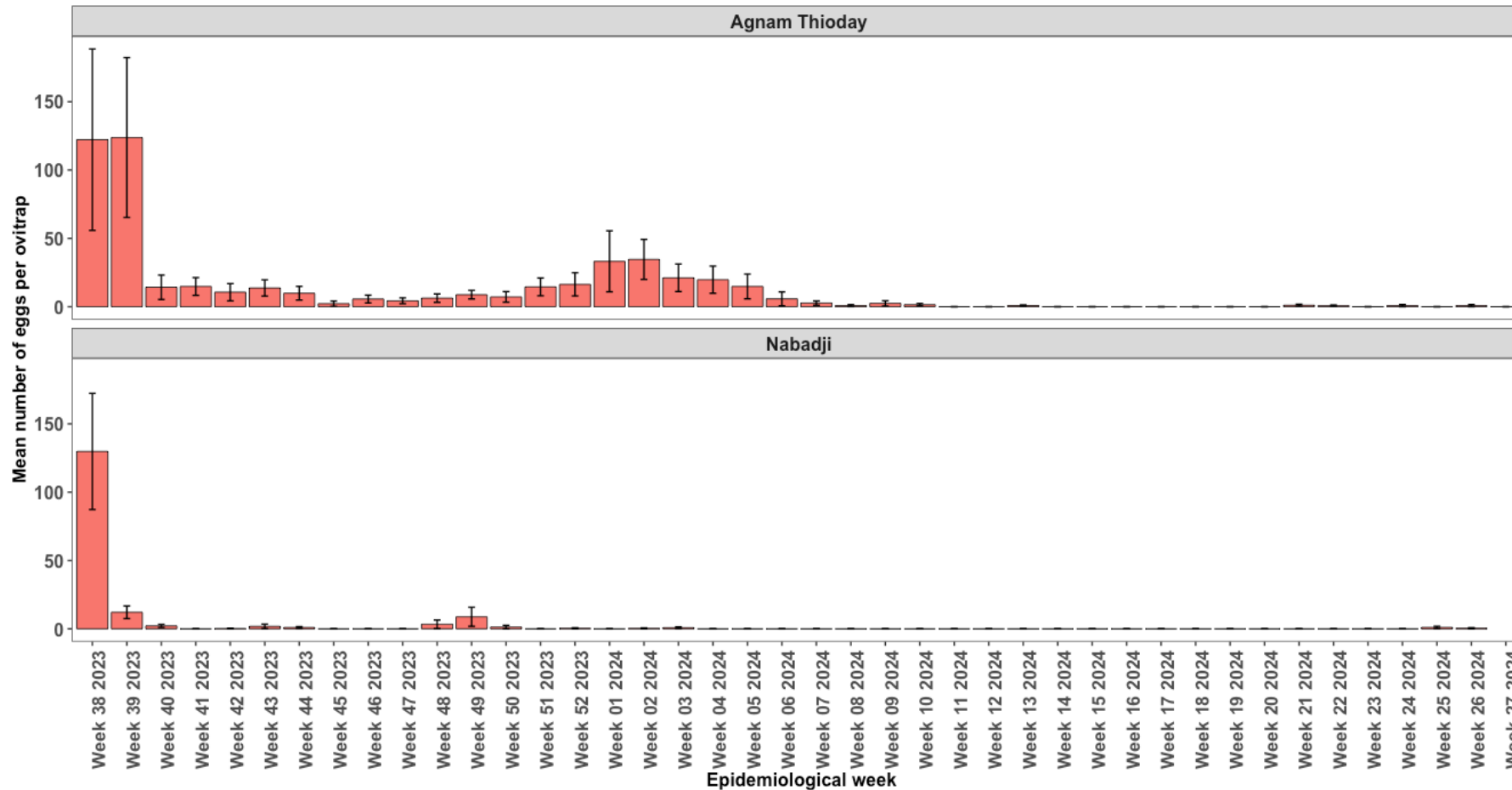
Entomological risk indices , Senegal

The entomological risk indices were above WHO epidemic risk threshold from September to November in Agnam Thiodaye, while in Nabadji, transmission risk was only observed in September .

In May and July 2024, none of the entomological indices was above WHO epidemic risk threshold except for HI in both localities.

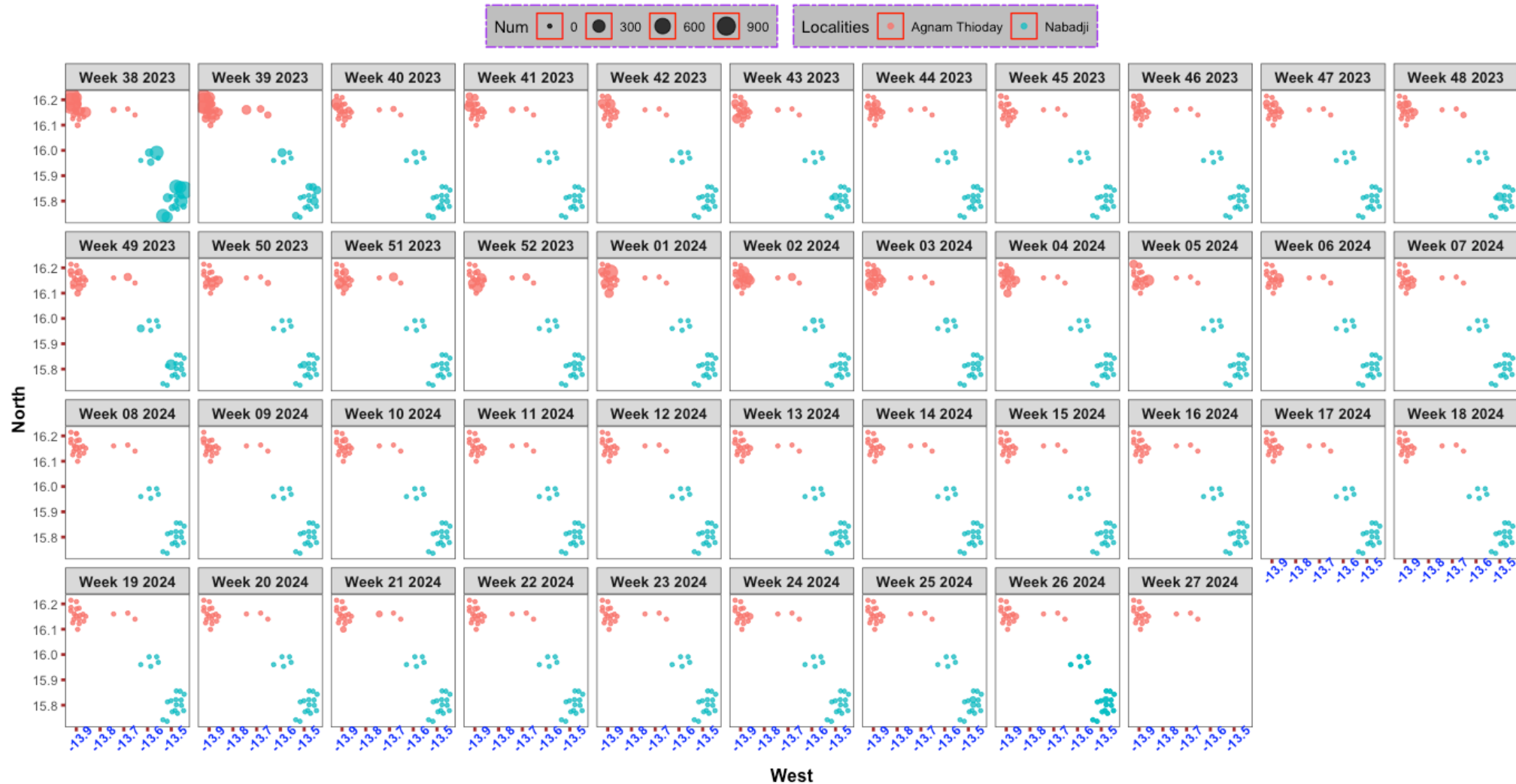


Egg density of *Aedes aegypti* , Senegal



- A total of 13572 mosquito eggs were collected during 41 full weeks of collection , with an average of 8,07 eggs per ovitrap per week. In the first 6 weeks of monitoring (weeks 34 to 39) , 70% of the ovitraps were positive
- The number of eggs per ovitrap ranged from 0 to 1162.

Spatial dynamics of *Aedes aegypti* egg-laying , Senegal



➤ Analysis of spatio-temporal dynamics showed a variability in the density of eggs collected.

Virological tests, Senegal & Nigeria

All the arbovirus vectors including *Aedes aegypti* , *Aedes vittatus*, *Culex poicilipes* and *Anopheles pharonesia* collected were tested for Dengue, Yellow Fever, Chikungunya, Zika, West Nil and Rift Valley Fever virus by real-time RT-PCR.

All the mosquitoes tested in 2023 were negative for all the arbovirus screened in both countries.

Mosquitoes collected in 2024 are under processing for virus detection.

Public Health Implications

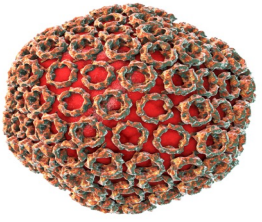
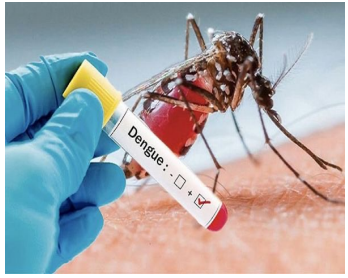
- ✓ **Early detection and rapid response:** These data enable the quick identification of vector proliferation hotspots, which is crucial for triggering timely and targeted interventions to prevent outbreaks of vector-borne diseases like dengue or yellow fever.
- ✓ **Resource optimization:** In a context of limited financial and logistical resources, entomological surveillance guides the efficient allocation of resources by identifying high-risk areas, allowing for the strategic deployment of control interventions.
- ✓ **Strengthening local capacities:** Surveillance programs can also serve to train local personnel, thereby enhancing local public health capacities and crisis management, while addressing logistical constraints and developing solutions tailored to the West African context.

Perspectives & Limitations

For future field missions, socio-economic factors, including **level of education**, **urbanization indicators** and **physicochemical parameters** of vector breeding sites will be included in the study to better understand the factors linked to transmission.

Limitations for Nigeria Entomology Team

- Eggs and larvae were not collected as there are planned to be incorporated going forward
- Only BG-Traps were used for adult mosquito collection



THANK FOR YOUR ATTENTION

