**EUROGEO WORKSHOP 2022** 

## **E4WARNING**

00000

# **Eco-Epidemiological Intelligence for early Warning and response to mosquito-borne disease risk in Endemic and Emergence settings**

Frederic Bartumeus, Alex Richter-Boix and

Guy Hendrickx





• E4WARNING



INTERDISCIPLINARY | INNOVATIVE | OPEN SCIENCE

Entomology

- Movement ecology
- Epidemiology
- Earth Observation science
- Sensor engineering
- Citizen science expertise
- Sociodemography
- Spatial statistical modelling



Funded by

the European Uni

Holistic ONE HEALTH approach to Improve our understanding of the interplay between humans, mosquitoes, reservoir species and the environment for a better disease intelligence capable of anticipating and identifying MBDs epidemic risk and outbreaks.



High quality real-time information on vectors for a scalable and flexible "epidemic intelligence"



EO data Hu seasonal climate water availability land use

> Estimate and anticipate mosquito prevalence and disease risk

How human activity produce differential disease exposure and contribute to the spreading of invasive mosquitoes and diseases



Ecosystem barriers to disease spreading

Host and vector dispersal capacities

Movement patterns in complex mosaic landscapes





Disease models in endemic settings

Dengue importation

Dengue forecasting in South Asia and endemic hotspots

Dengue prevalence in endemic areas and global traffic patterns will anticipate connectivity and importation risk

#### EUROGEO WORKSHOP 2022 | Athens 7-9 December • E4WARNING





Model water availability dynamics and build hydrometeorological indicators from harvesting EO data to anticipate mosquito prevalence in urban areas and potential spillovers from wetlands.



Use EO data to develop vector and host distribution spatial models at different scales (regional, continental) and to enable climate-driven disease risk forecasting.

Higher capacity to trace environmental and biological change (dynamics and interactions) introducing novel technologies (ground sensors, mobile phones, Internet) and citizen science, making citizens part of the solution.



Quantify ecosystem barriers/connectivity to MBDs spreading using: environmental (climate, land uses, hydrometeorology) and biological (human mobility, dispersal capacities and behavioural activity of vectors and hosts) data.



Explore main activity circuits connecting humans, mosquitoes and birds to identify risk factors, and possible pathways and barriers for disease circulation. Identify strategies to make more resilient ecosystems in mosaic landscapes: urban and natural areas.

#### **ACTIONABLE RESEARCH**

All research & EW modelling will be integrated in operational frameworks following a QH open innovation model. Push the state-of-the-art of EWS and generate evidence-based and next-level knowledge to inform One Health management.



### • E4WARNING

#### Innovative mosquito surveillance in urban environments



human-to mosquito-to human urban cycle Aedes aegypti / Aedes albopictus





- Citizen science
- Traditional surveillance
- IoT Smart traps
- Earth Observation data
- Climatological data
- Human activity-spaces
- Human mobility



- Vector presence
- Vector phenology
- Vector abundance
- Vector activity
- Human-vector interaction
- Vector passive dispersal

#### Innovative mosquito surveillance in urban environments

#### Extending the "smart city" model of Barcelona



Area

### • E4WARNING

### 

Wetlands and peri-urban areas to study pathogen spillover potential from wetlands



- self-Mark and Capture (*Culex*)
- Mark-Release-Recapture (*Aedes*)
- Biologging of birds in field
- Human-vector interaction
- Human mobility
- Vector dispersal capacity
- Reservoirs home ranges
- Reservoirs behaviour activity
- Vector activity
- Human-vector interaction
- Vector passive dispersal

Wetlands and peri-urban areas to study pathogen spillover potential from wetlands





BIRDS BIOLOGGERS: Candidate bird reservoirs species will be deployed with WildFi tracking devices



#### MARK-RELEASE-RECAPTURE (MRR) &

self-MARK AND CAPTURE (sMC): To estimate dispersal capacity and dispersal-mediated connectivity between wetlands, peri-urban and urban areas of *Aedes albopictus* & *Culex pipiens* 

- Aiguamolls de l'Emporda (Spain)
- Sichinia-Marathona (Greece)
- Bodanrück (Germany)
- Bolle di Magadino (Switzerland)

Aedes albopictus introduced + DENV imported
Culex sp. WNV suspected



## • E4WARNING

Disease models in Endemic settings





1:00

• E4WARNING





• E4WARNING









upf. Universitat Pompeu Fabra Barcelona innovation partners



Benaki Phytopathological Institute







Barcelona Supercomputing Center Centro Nacional de Supercomputación



**HR** Wallingford

