

ONE HEALTH APPROACH IN RESEARCH AND SURVEILLANCE OF WEST NILE VIRUS

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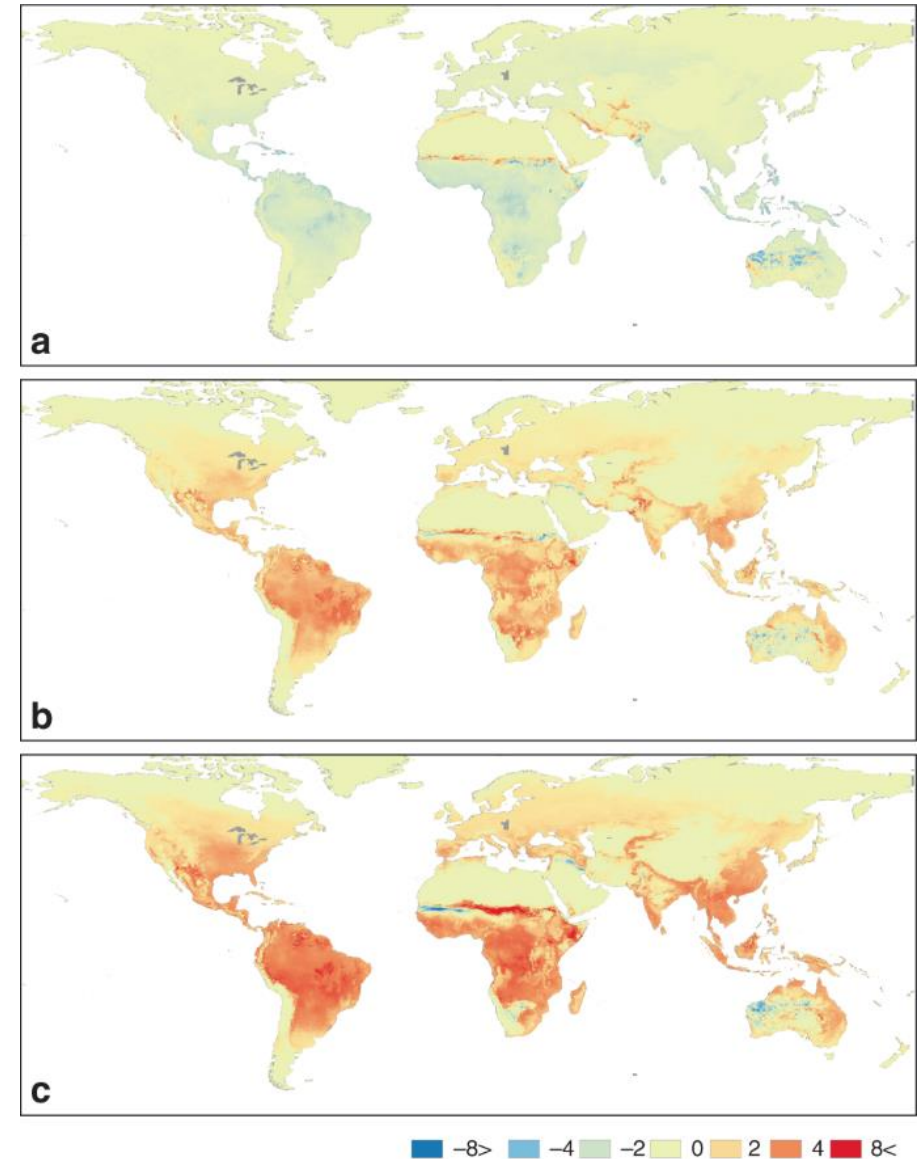
Erasmus MC





NUMBER OF GLOBAL ABUNDANCE AND LIFE-CYCLE COMPLETIONS AEADES SPP.

- The change in the potential of global abundance in *A. aegypti* over the last century: estimated 9.5% increase globally
- Further estimated increase of 20 or 30% by 2100
- Same pattern when looking at (increased) number of life cycle completions



Iwamjura et al, 2020, nature comm, 2020;
Liu-Helmersson et al, 2019

CLIMATE CHANGE:

Changes in vector distribution and vector competence, but also: changes in bird migration and resident bird populations

Threats to European–African migrants

Bird populations are in steep decline despite not migrating across the blackspots of illegal killing. Habitat degradation and loss are likely the most important causes, but climate change also affects populations.

Climate change

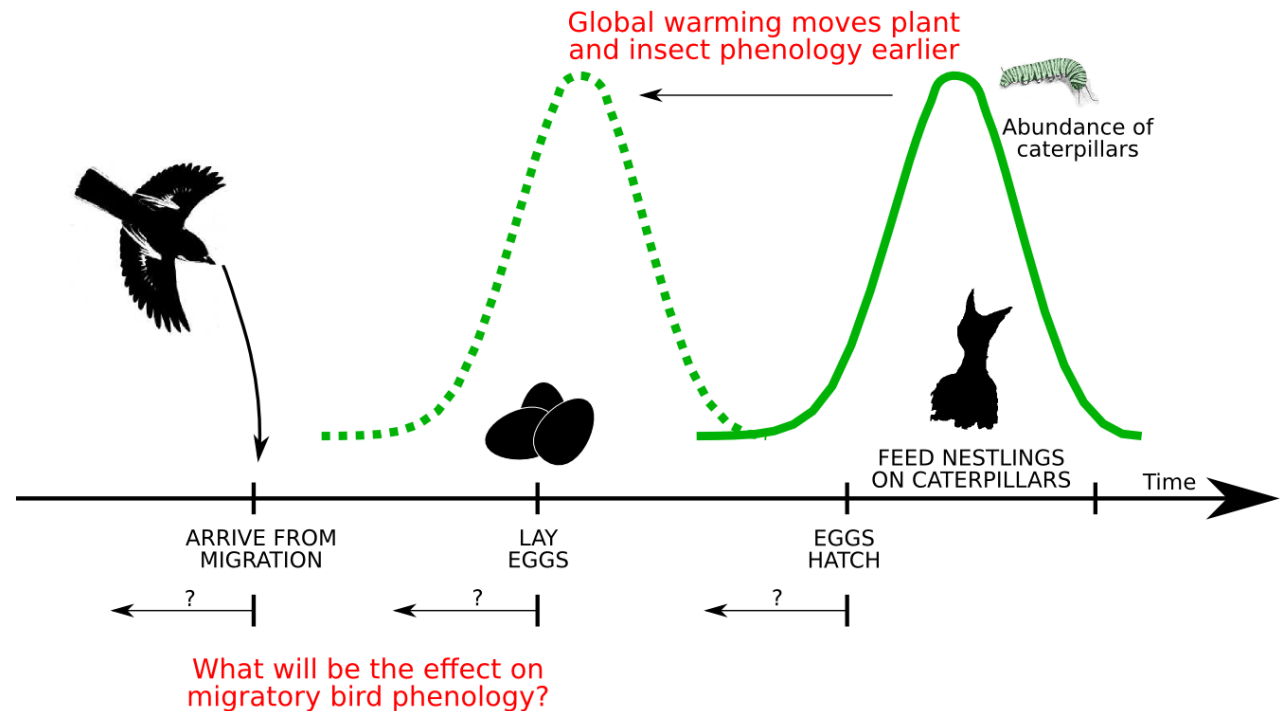
Earlier arrival at breeding grounds causes ecological mismatch between birds and their insect prey.

Habitat degradation and loss

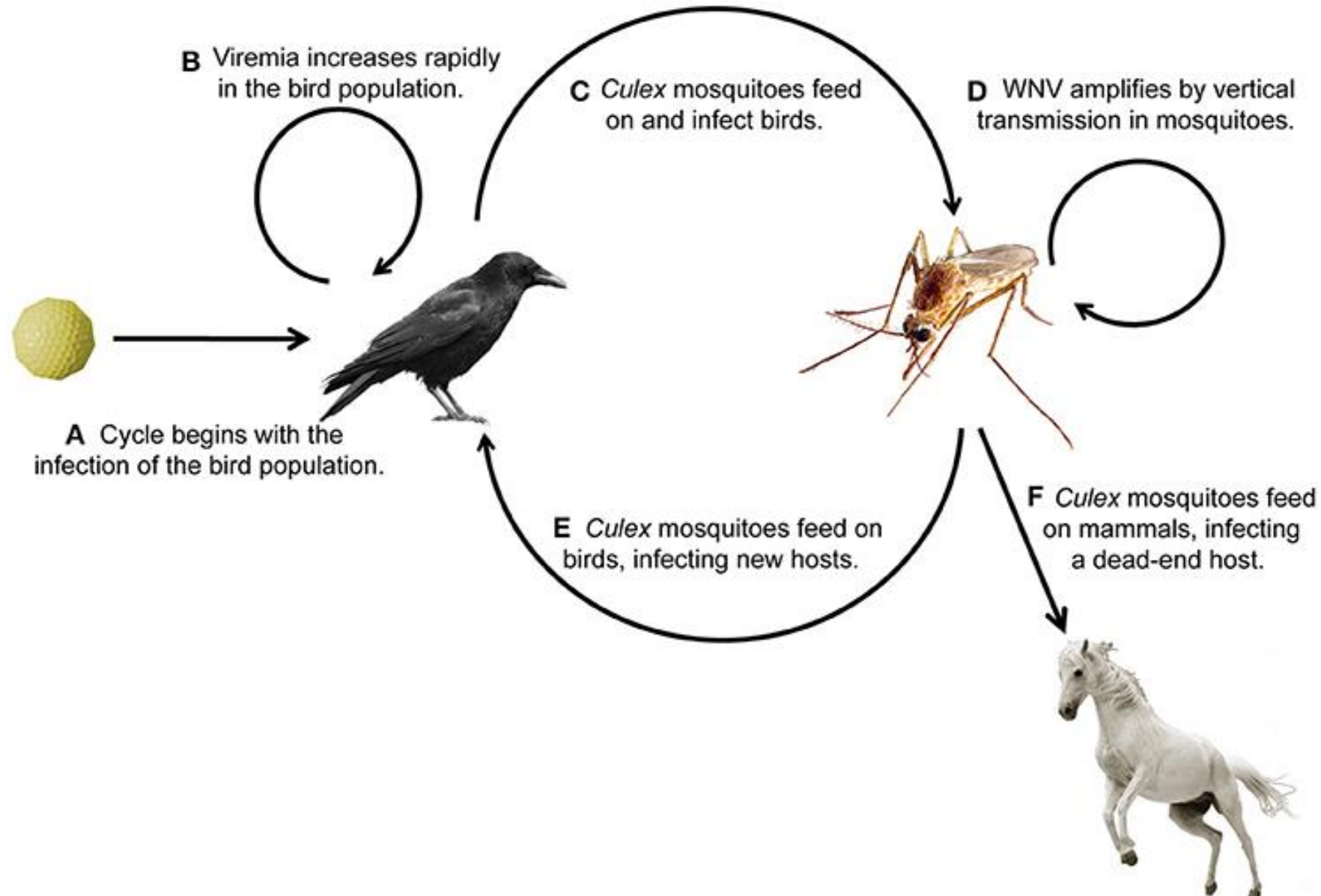
Increase in agriculture at the expense of natural vegetation affects birds at breeding sites, winter habitats, and along migratory routes.

Illegal killing

Concentrated in the eastern Mediterranean (black dots)



West Nile Virus



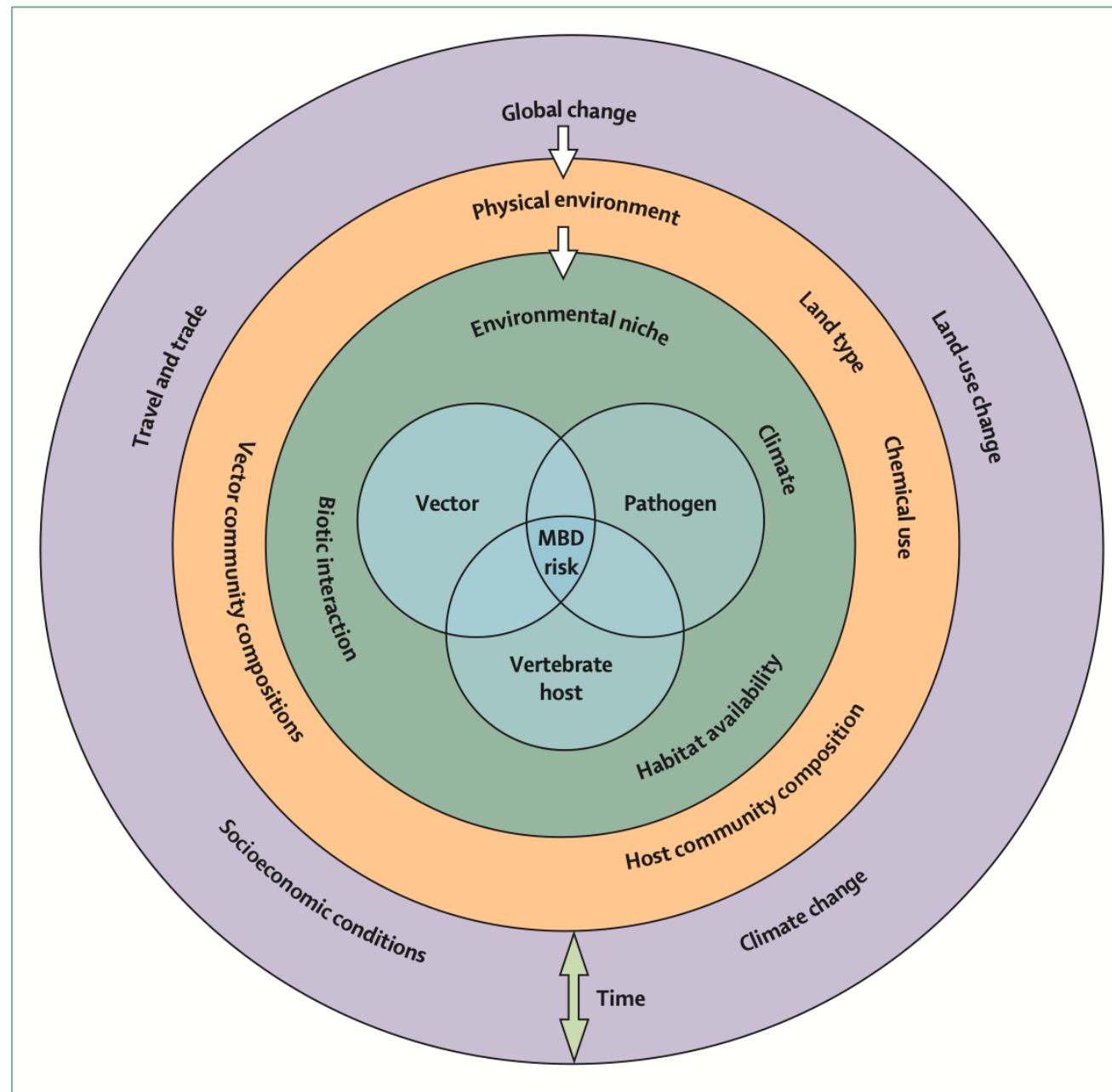
Conceptual model for system approach to understanding vectorborne diseases

Enhancing EID
preparedness

Through innovative
intelligence

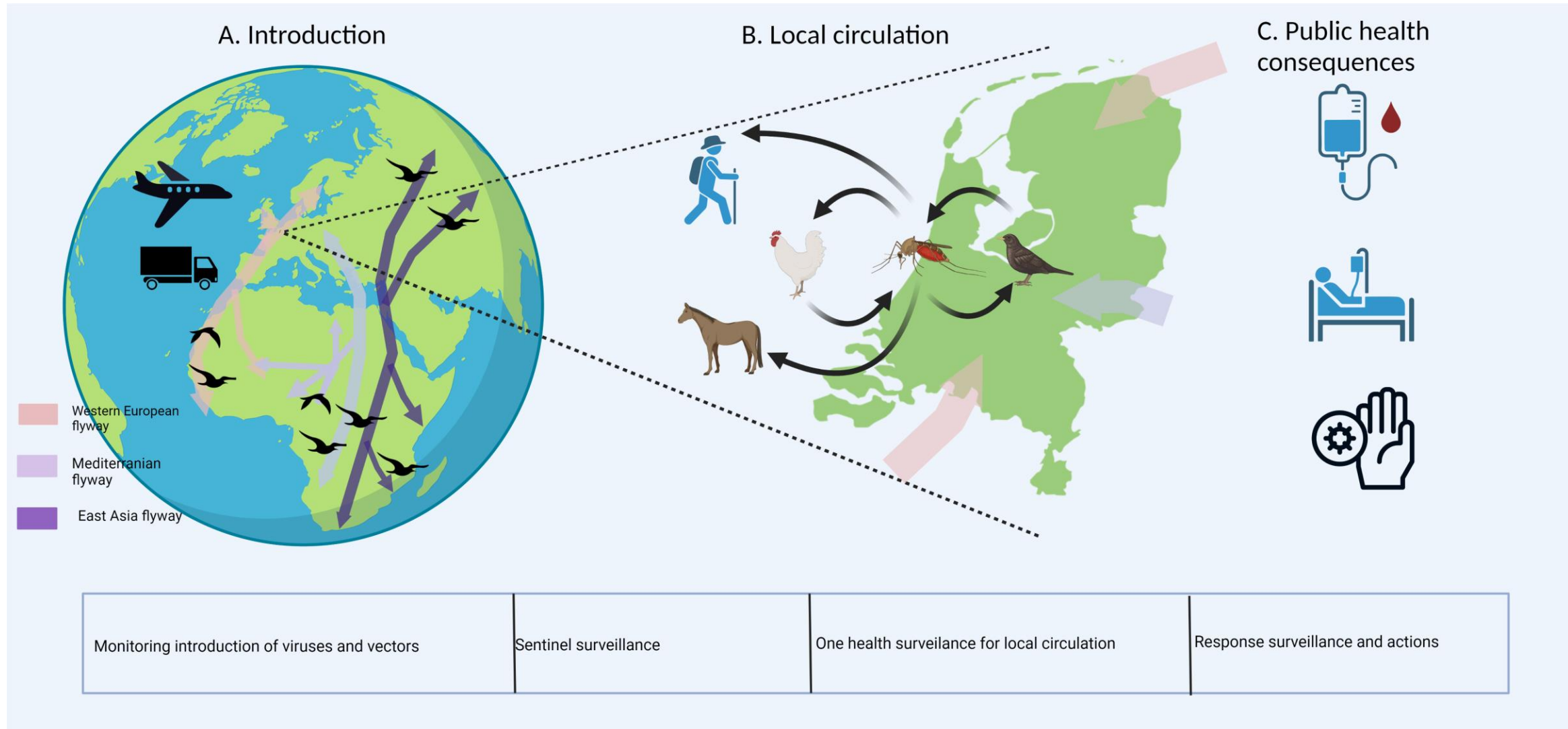


Ecocentric/One Health

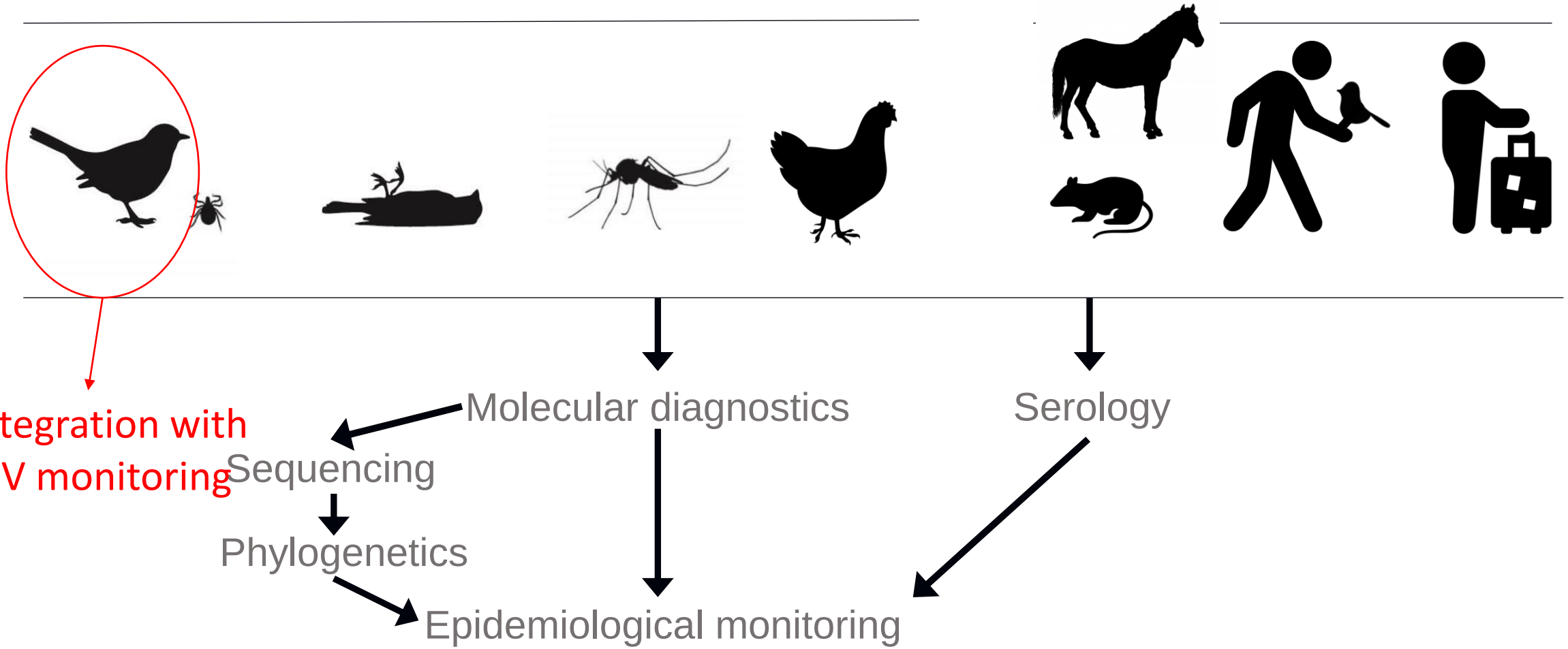


Franklinos et al Lancet Infectious Diseases 2019
One Health High-Level Expert Panel

ONE HEALTH SURVEILLANCE (1)



ONE HEALTH SURVEILLANCE (2)



MOSQUITO COLLECTION

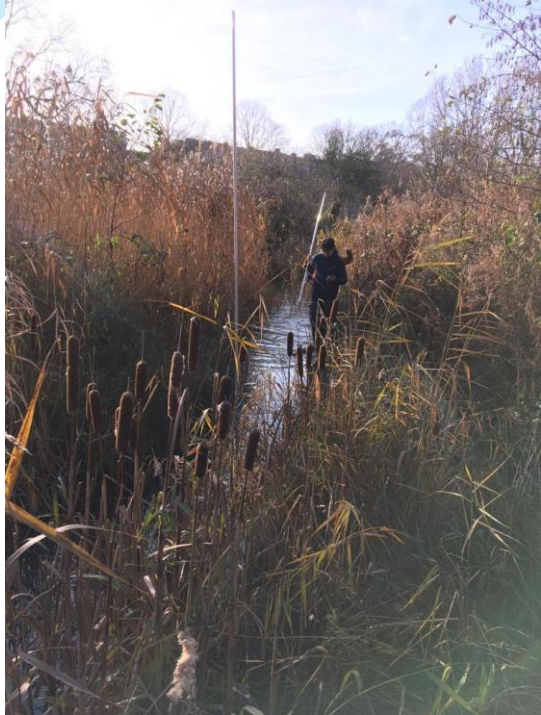


Looking for overwintering sites
- Aspirator -

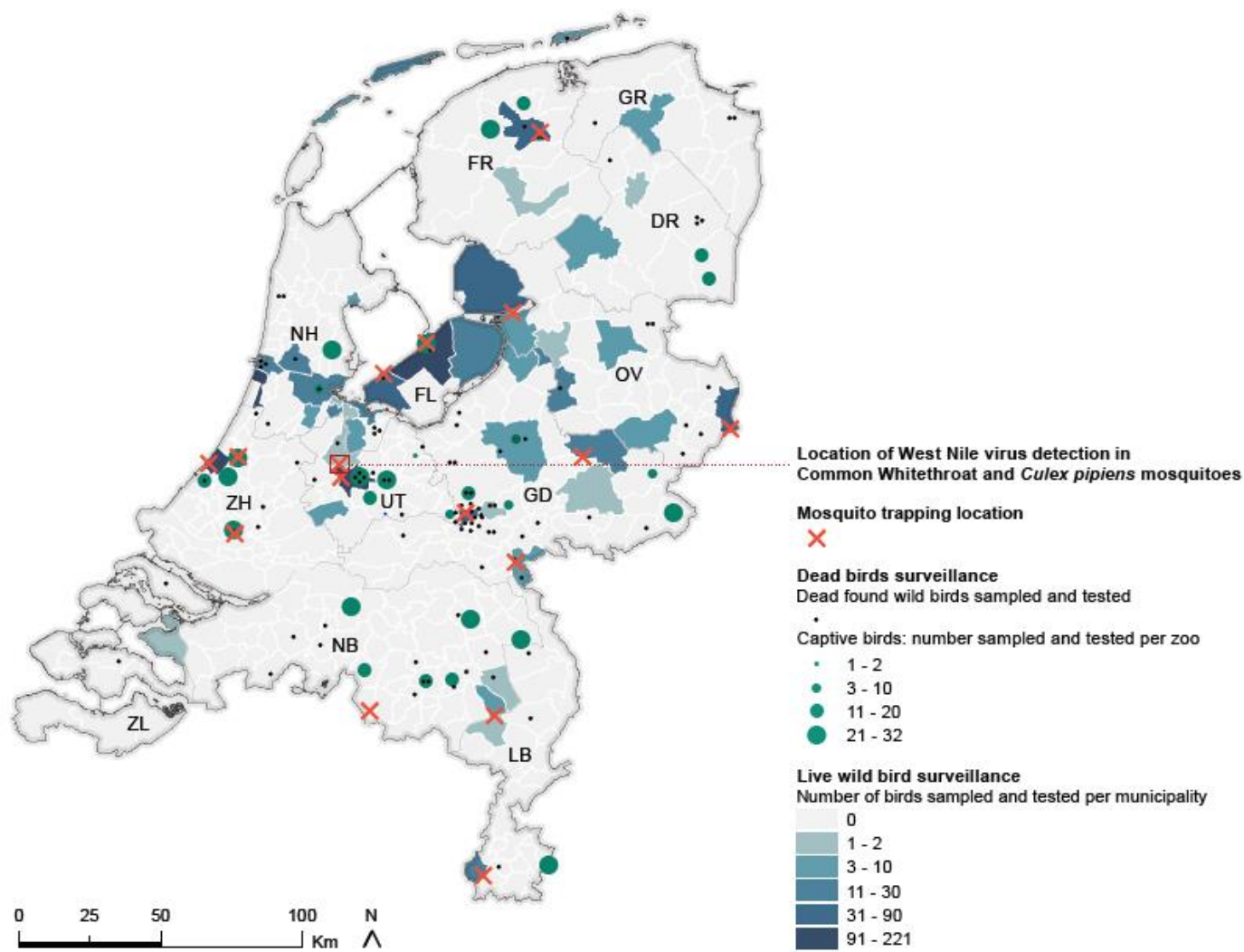


Mosquito trapping on bird ringing sites
- molasses fermentation-baited BG-pro traps

WILD BIRD TRAPPING



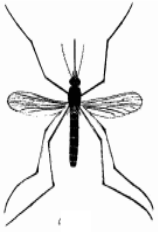
2020: DETECTION OF WEST NILE VIRUS IN THE NETHERLANDS



2020: DETECTION OF WEST NILE VIRUS IN THE NETHERLANDS



Common whitethroat, Utrecht, 22 August



2/44 *Culex* mosquitoes pools from regular surveillance, Utrecht, August and September

3/101 *Culex* mosquitoes pools from increased surveillance, Utrecht, September

Rapid communication

Open Access

First autochthonous human West Nile virus infections in the Netherlands, July to August 2020

Like 0

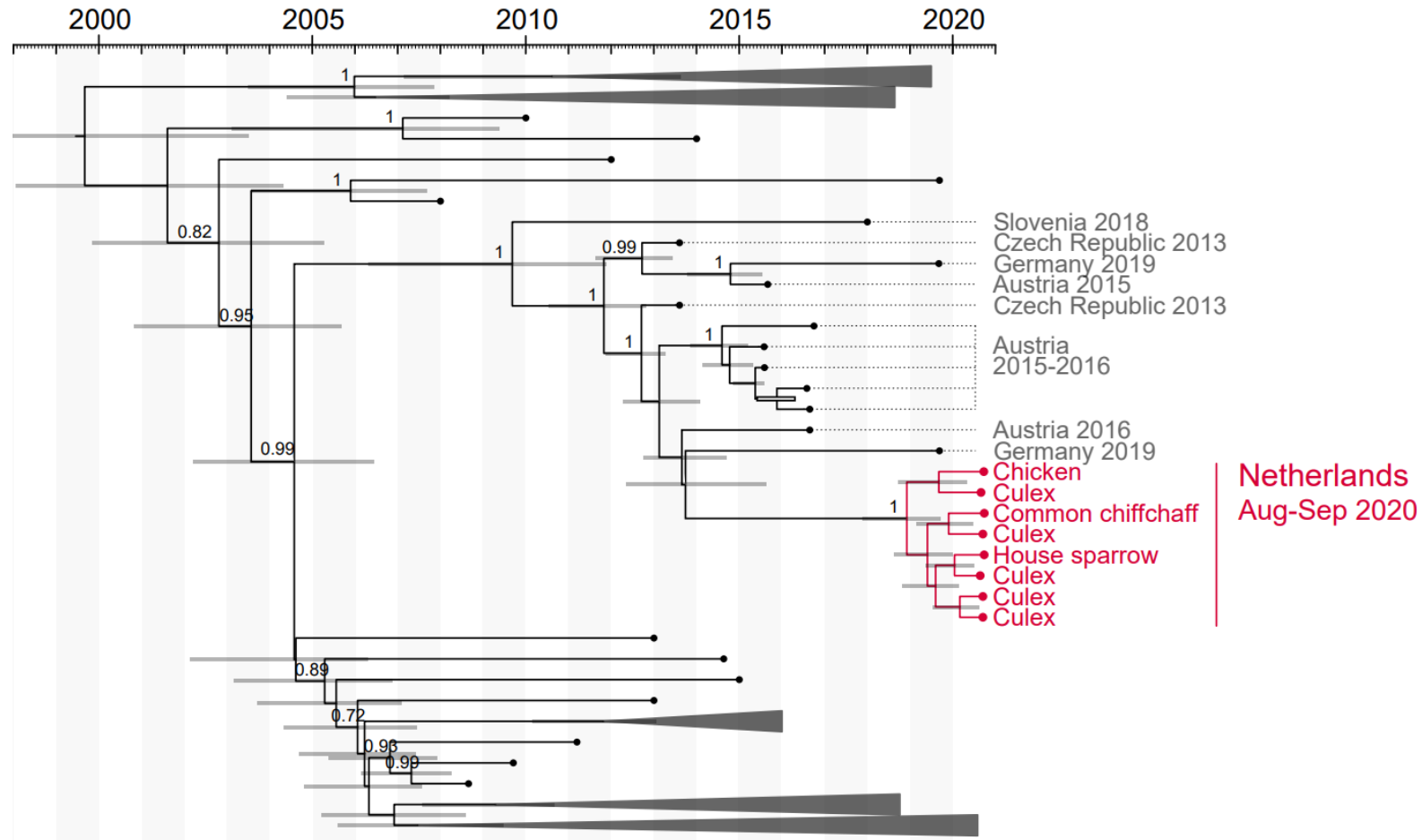


Check for updates

Download

Danique RM Vlaskamp^{1,2}, Steven FT Thijsen^{2,3}, Johan Reimerink^{2,4}, Pieter Hilken¹, Willem H Bouvy⁵, Sabine E Bantjes⁴, Bart JM Vlamincx⁶, Hans Zaaijer⁷, Hans HTC van den Kerkhof⁴, Stijn FH Raven^{2,4,8}, Chantal BEM Reusken^{2,4}

ANALYSIS OF GENETIC INFORMATION



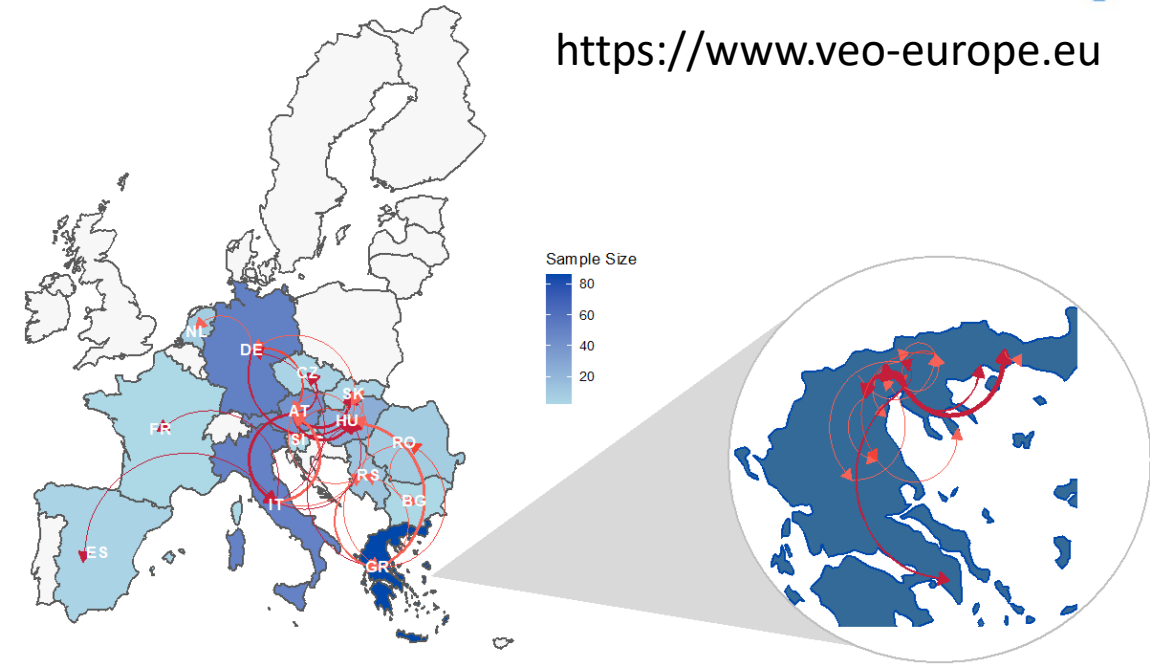
- Sequences from the Netherlands are closely related: **one introduction?**
- Clusters with Germany 2019 sequences (**origin?**)
- Predicted ancestor dates from (between Nov 2017-Sep 2019, 95% CI)
(**moment of introduction?**)

Oude Munnink et al, unpublished

WNV DISPERSAL EUROPE / INCURSION SOURCE NL



<https://www.veo-europe.eu>



Combined with other types of data as potential explanatory variables

Mammal species richness

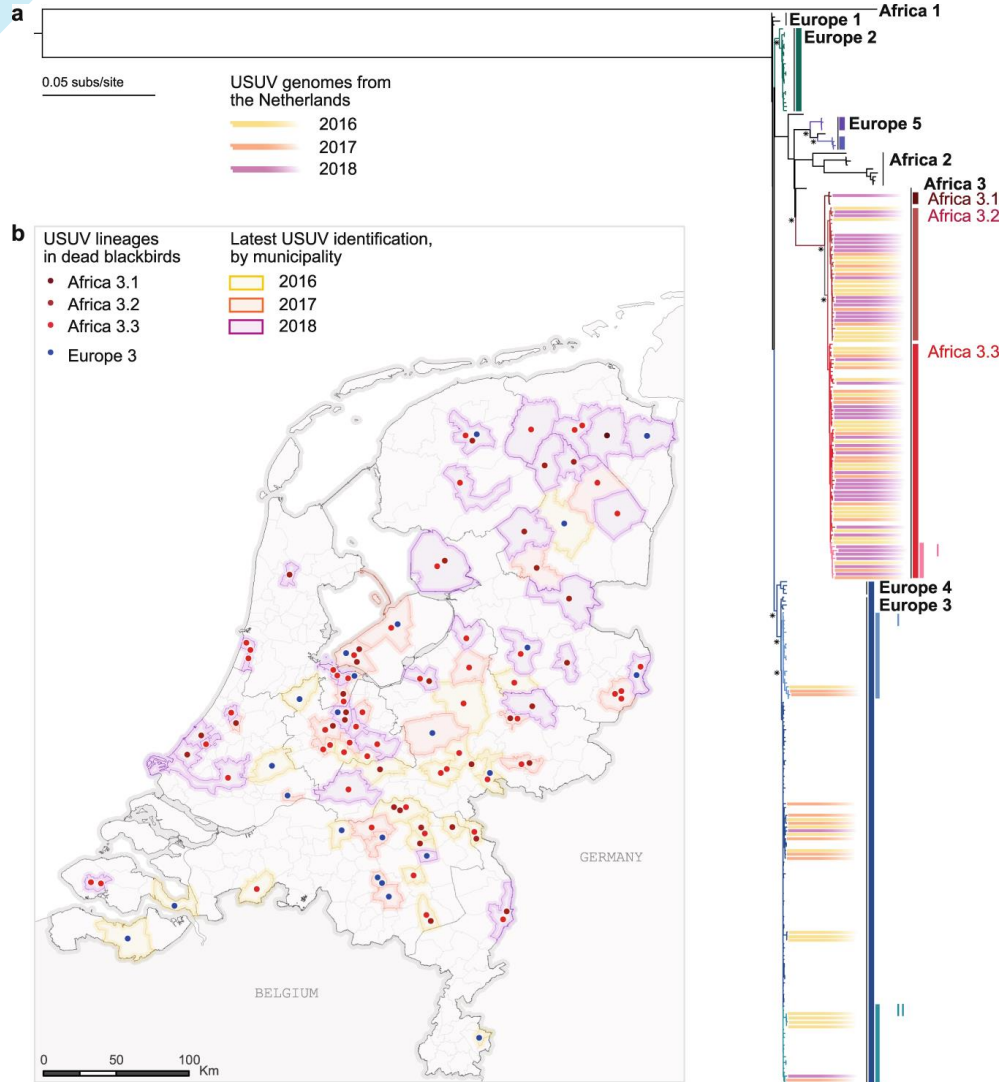
Bird species richness

Climate - time – temperature – precipitation

Human density

Farm/4/urban land density

USUTU VIRUS AS A MODEL FOR WNV ?



- Same virus family, as well as wild bird hosts and mosquito species as vector
- Frequent detections in the Netherlands, including in blood donors (Zaaijer et al)
- USUV much more prevalent
- Likely overwintering (but where?)

WNV IN THE NETHERLANDS - 2022

- Partial genome of 479 nucleotides
- **Clusters with 2020 Dutch sequences**
- Additional partial sequence information confirms this connection

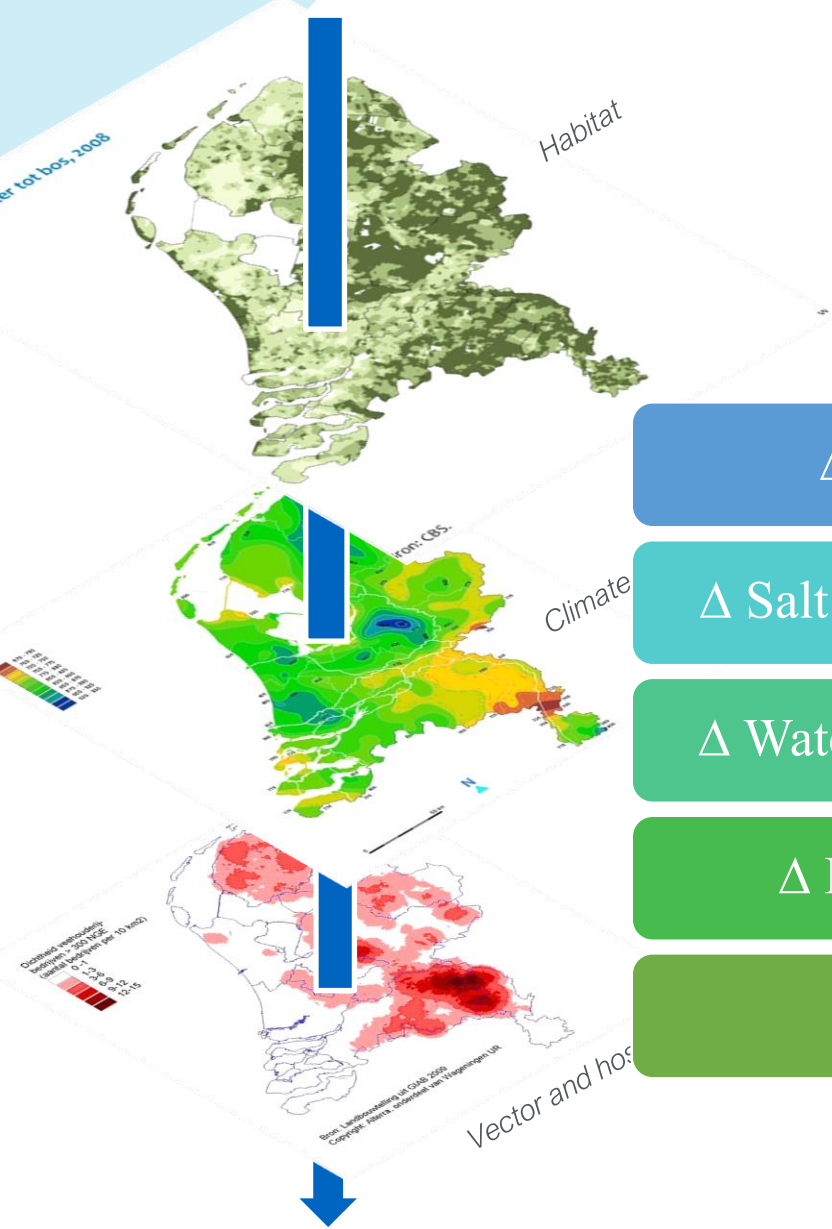


CONCLUSION

- Arbovirus burden of disease is expected to increase in coming decades
- Arbovirus surveillance and research requires a One Health / Ecohealth approach
- Animal and vector surveillance can serve as early warning for WNV circulation



CAN WE PREDICT EMERGENCE OF ARBOVIRUSES?



Δ Climate

- Extreme rainfall and long term drought
- Temperature

Δ Salt concentrations

- Groundwater upwelling
- Salt intrusion

Δ Water management

- Wetland development
- Water storage in cities (e.g., roofs)

Δ Mosquitoes

- Abundances
- Species composition

Δ Birds

- Species composition and abundance
- Movements

Changes in
Disease risk



ACKNOWLEDGEMENTS

- ErasmusMC

Marion Koopmans
Bas Oude Munnink
Nnomzie Atama
Emmanuelle Munger
Irina Chestakova
Anne van der Linden
Felicity Chandler
Marjan Boter

- NIOO-KNAW

Henk van der Jeugd
Tijs van der Berg
Natasja van Nijen

- DWHC

Judith van der Brand
Andrea Grone

- WUR

Rody Blom
Sander Koenraad

- LU-CML

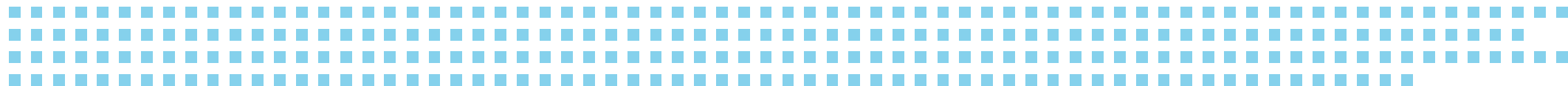
Maarten Schrama

- UvA

Eldar Rakhimberdiev
Judy Shamoun-Baranes
Willem Bouten

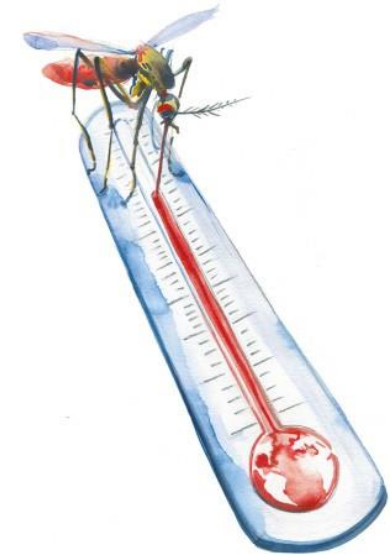
And many others..





EFFECTS OF CLIMATE CHANGE ON VECTORBORNE DISEASES: NOT ALWAYS STRAIGHTFORWARD

- Climate change can have direct effects on vectors, non-human hosts and humans
 - This will in turn influence transmission dynamics, geographic spread and re-emergence of vector-borne diseases
1. Temperature
 - Higher (too high) temperatures can also have a negative effect on vector competence (f.e. vector survival, adult body size and feeding)
 2. Precipitation
 - can affect vector breeding habitat both in positive and negative ways
 3. Host abundance, behaviour and movement
 - subsequent effect on dispersal and spread of vectors and viruses



Birds and mosquito borne viruses (arboviruses)

- Wild birds are reservoir host for several arboviruses
 - West Nile Virus (WNV)
 - Usutu Virus (USUV)
 - Japanese Encephalitis Virus (JEV)
 - Equine encephalitis viruses (EEEV, WEEV, VEEV)
 - Sindbis Virus (SINV)
 - and more..
- Birds play a role in the **introduction** and **spread** of these viruses
- Birds also carry **ticks**, which are transported along bird migration routes