Valorisation autour de la lutte antivectorielle
28 avril 2022

ADN environnemental (ADNe)
Environmental DNA (eDNA)

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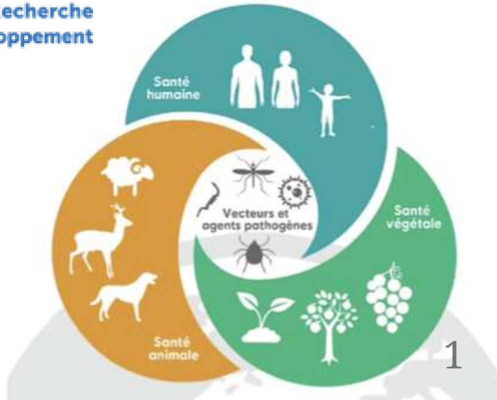

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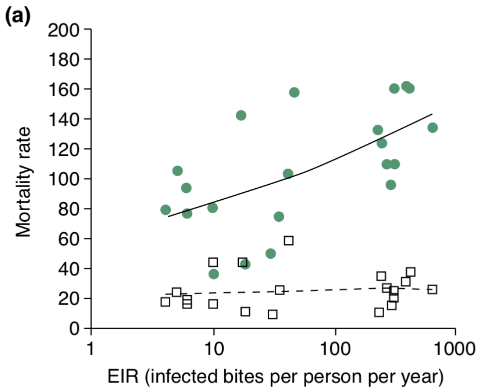
What is the scope of vector surveillance

1. Assess the risk of disease emergence (in pathogen-free areas)
2. Evaluate the strength of pathogen transmission (in endemic areas)
3. Evaluate the efficacy of control interventions (before/after control)
4. Assess the risk of transmission re-emergence (after successful control)



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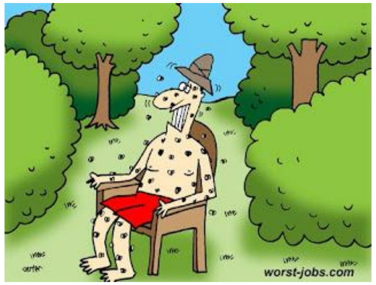
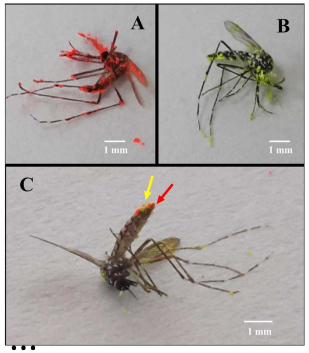
Tools for vector surveillance

- Producing **relative indices**[1] of vector abundance/transmission
  - Collections on hosts, in natural or artificial habitats, etc.
  - Trapping devices



- Producing **absolute estimates**[2] of vector abundance/transmission
  - Capture-Recapture (but some of the previous sampling tools are needed anyway)



[1] i.e. per human, per trap, per household, per collection device, …

[2] i.e. per unit surface.

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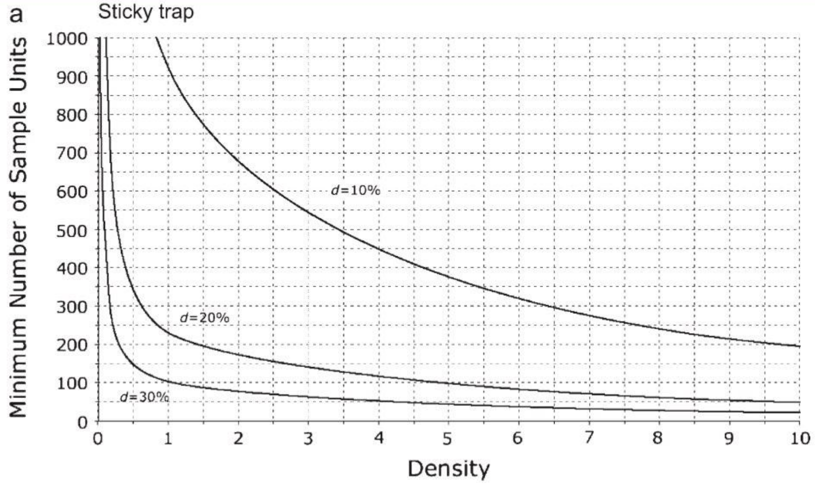
Cons of 'traditional' tools for vector surveillance

1. Active, 'destructive' sampling
2. Ethical constraints (e.g. exposure of human baits to pathogens)
3. Dependence upon idiosyncracies of vector behaviour
4. Often massive and sometimes unknown sampling biases
5. Low cost/effectiveness at low vector densities
6. Costs
7. Often highly imprecise estimates

Ex. Precision of sticky traps for sampling adult *Aedes albopictus*



Minimum number of traps needed to obtain estimates of mosquito density ±*d*% of the sample mean (Facchinelli *et al* 2007 Med Vet Entomol 21:183)

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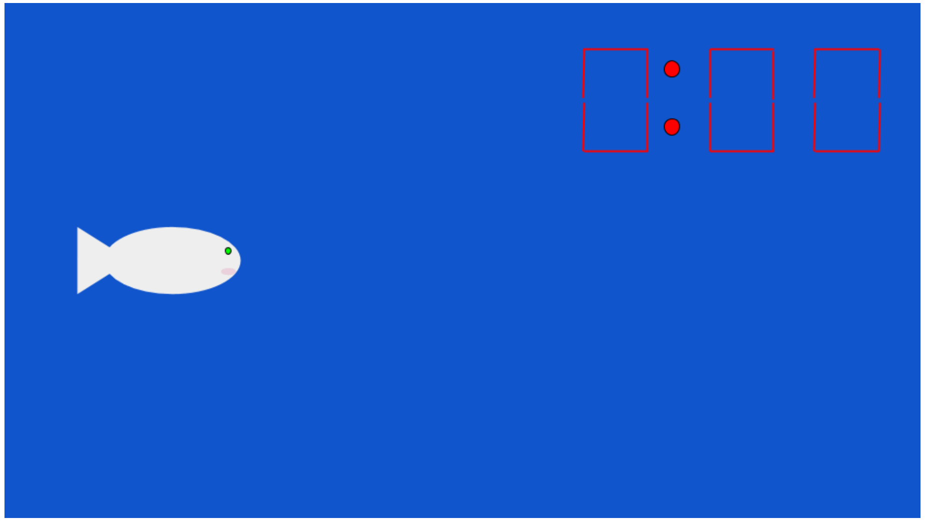
What is eDNA

> Environmental DNA (eDNA) is organismal DNA that can be found in the environment.
>
> Environmental DNA originates from cellular or extra-cellular material shed by organisms (via skin, excrement, hairs, etc.) into aquatic, aerial, or terrestrial environments that can be sampled and monitored using molecular methods.

(Source: modified from https://www.usgs.gov)



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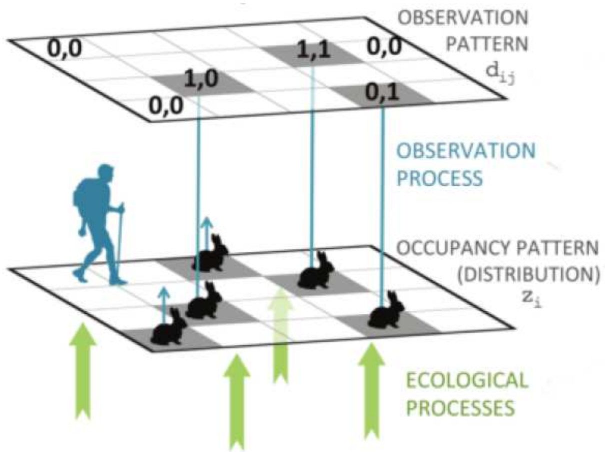
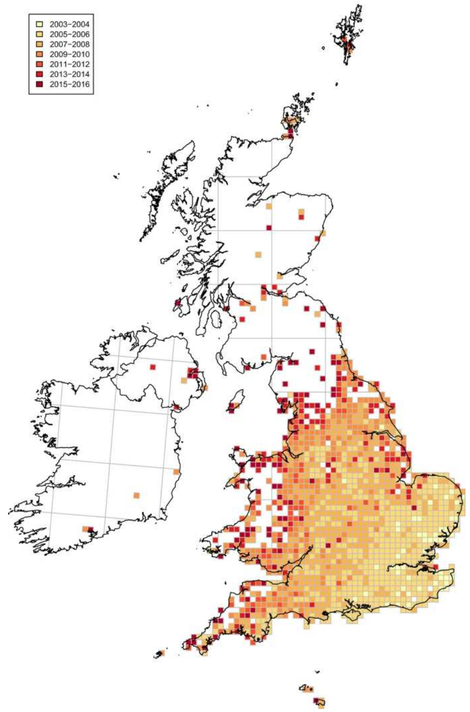
How can eDNA be useful in vector surveillance

- Data about presence/absence
  - Population distribution
  - Population abundance
  - Risk maps & Spread of invasive species





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How can eDNA be useful in vector surveillance

- To evaluate population parameters involved in vectorial capacity

Vector feeding behaviour

Ex. eDNA from plant tissues on/in/from insect vectors.

Vector density & demography

Ex. Genetic fingeprints in Capture-Recapture studies.

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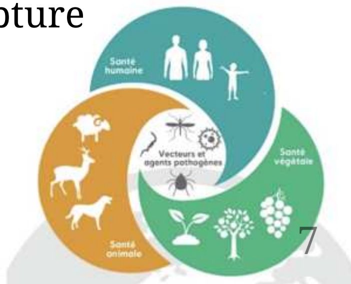

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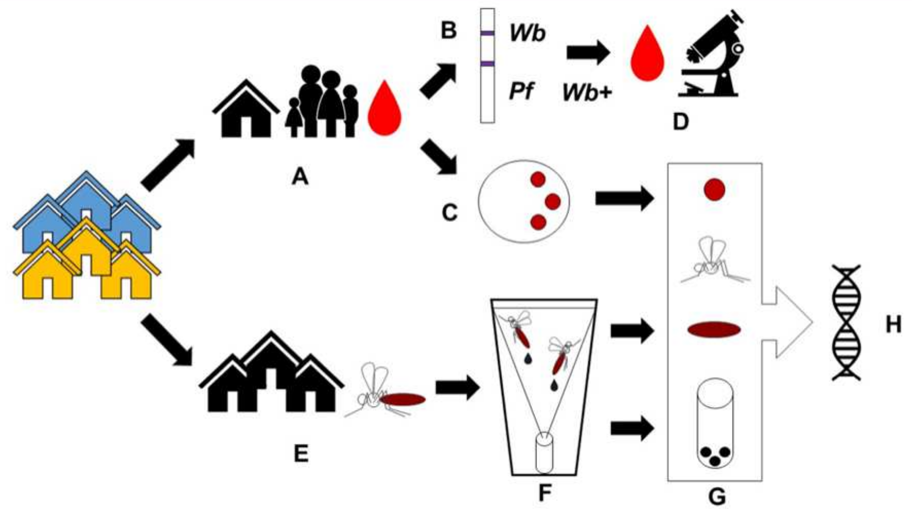
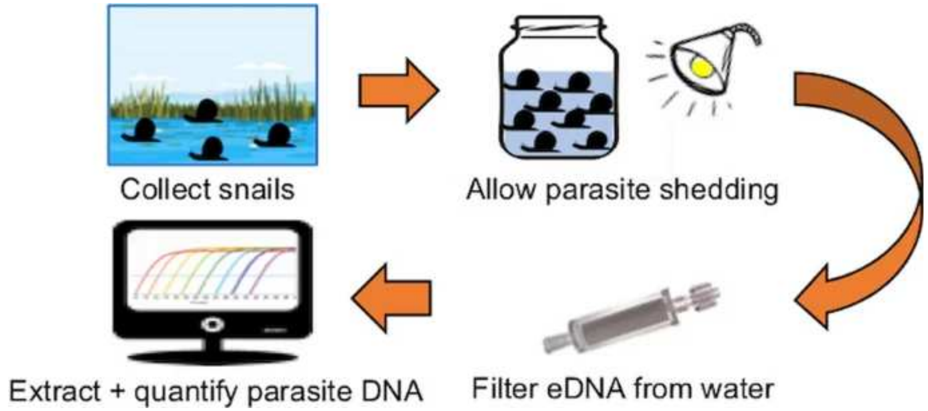
How can eDNA be useful in vector surveillance

- To detect the presence of vector-borne pathogens in the vector or in the environment



Ex. Xaenomonitoring of *Wuchereria bancrofti* and *Plasmodium falciparum* from mosquito vector excreta.



Ex. Xaenomonitoring of *Schistosoma* eDNA from water samples harbouring snail vectors.

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What are the Pros & Cons of eDNA

PROs

1. Passive, non-invasive sampling
2. Low dependence on complex vector behavioural responses
3. Lower sampling biases
4. Sensitivity (high effectiveness at low vector densities)
5. Specificity (lower probability of misidentification)
6. Possibility of scaling-up sampling plans (e.g. metabarcoding, citizen science via e.g. RDTs)
7. Capture-Recapture by genetic fingerprints

CONs

1. Costs (but bound to decrease as NA technologies constantly improve)
2. Skills (but RDTs can be developed)
3. Problems of sample contamination
4. Low abundance of sample raw material
5. Weak or non-linear functional relationship [eDNA] ~ density

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Technical challenges

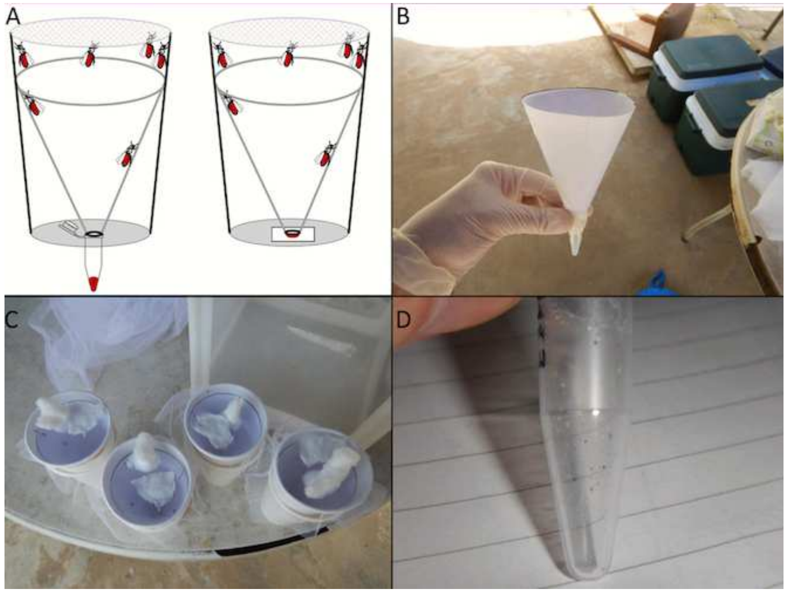
- eDNA degradation

Ex. Self-preserving eDNA filters.

Technical challenges

- Sample collection and handling

Ex. Superhydrophylic surfaces to concentrate vector excreta in reaction tubes.



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