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Can Gene Drives help Eliminate Vector-borne Diseases?

Brian B. Tarimo, PhD

Senior Research Scientist

16th Nov 2023

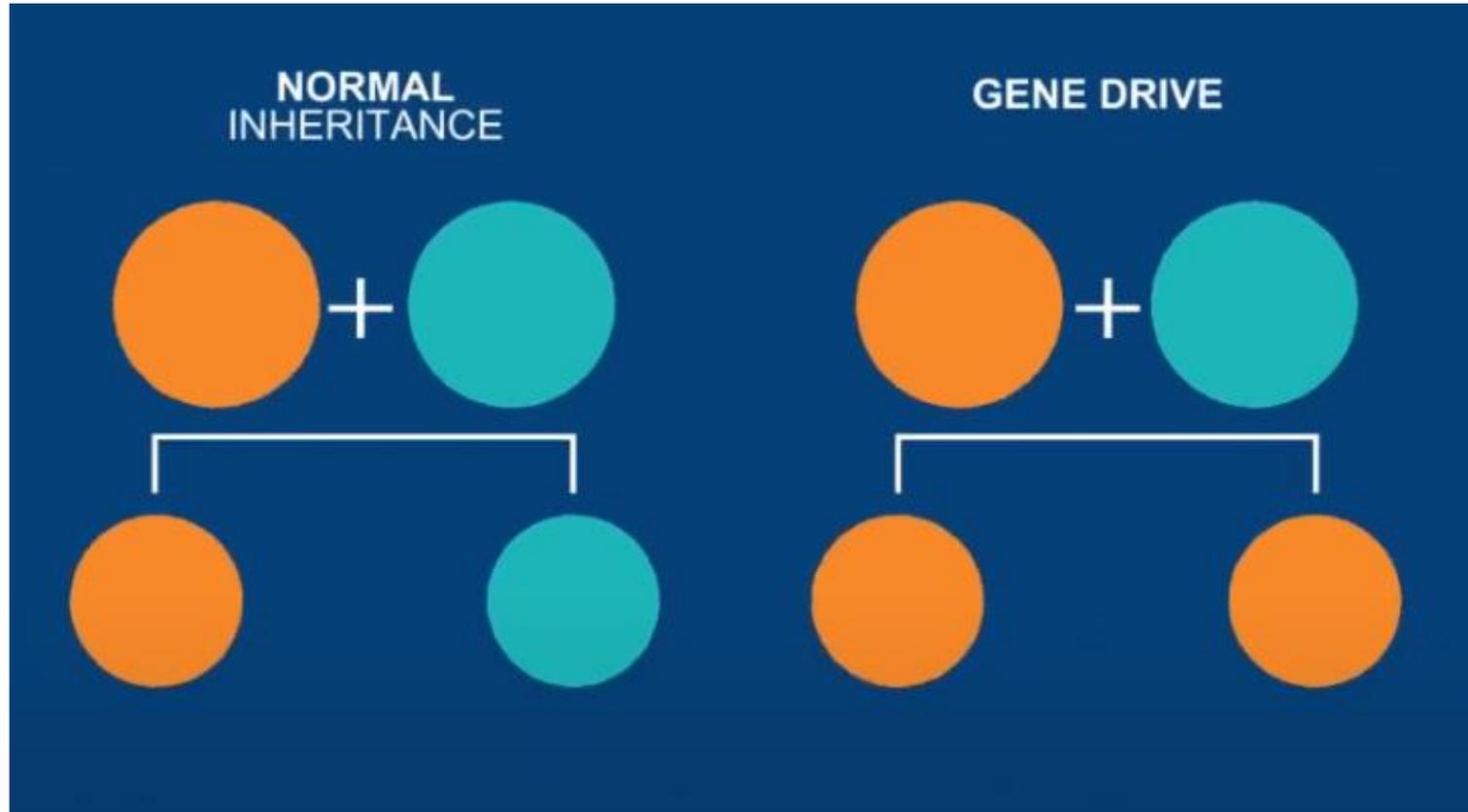
Genetic Tools For Conservation and Health: What's The Role of Gene Drives
16th Nov 2023

Outreach Network for Gene Drive Research and International Service for the
Acquisition of Agribiotech Applications Webinar Series



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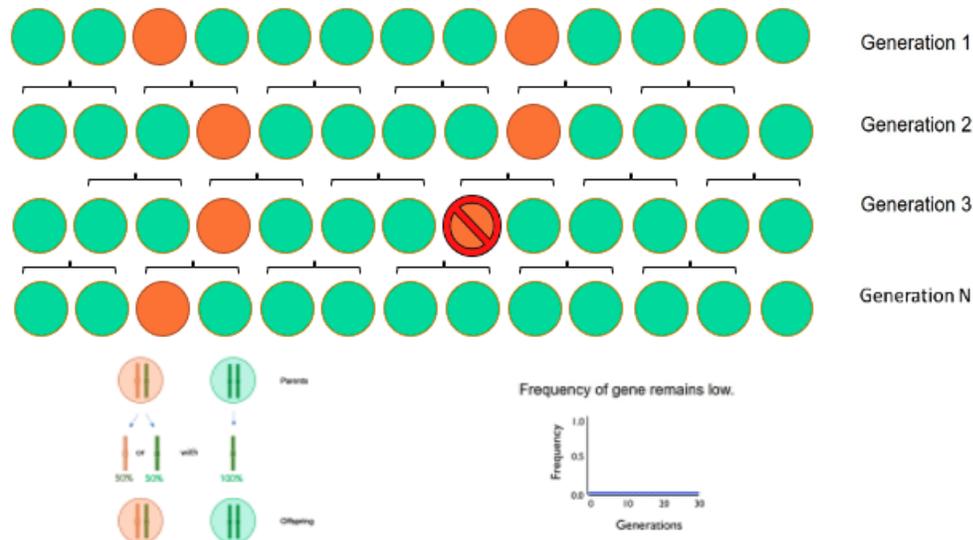
What is a Gene Drive?



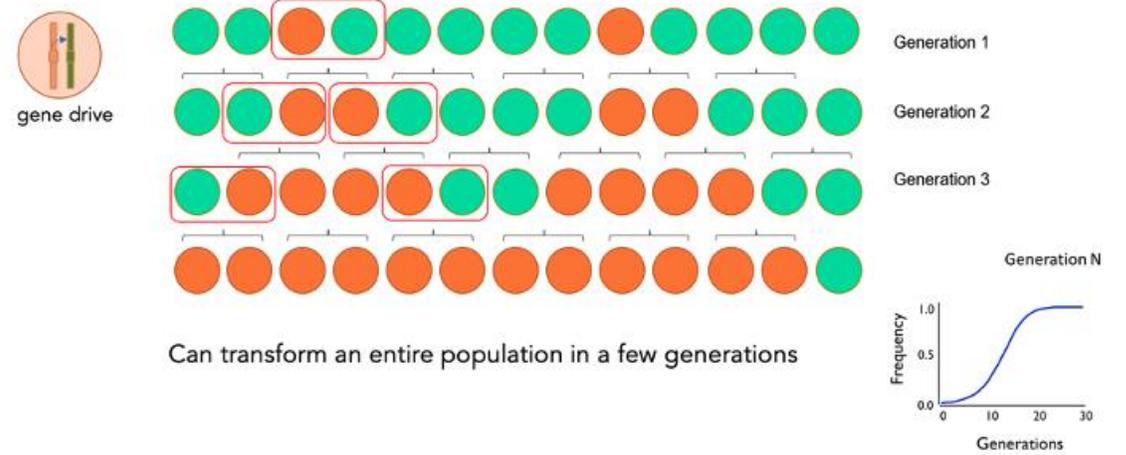
“any genetic element that is able to bias its own inheritance among offspring”

What is a Gene Drive?....cont'd

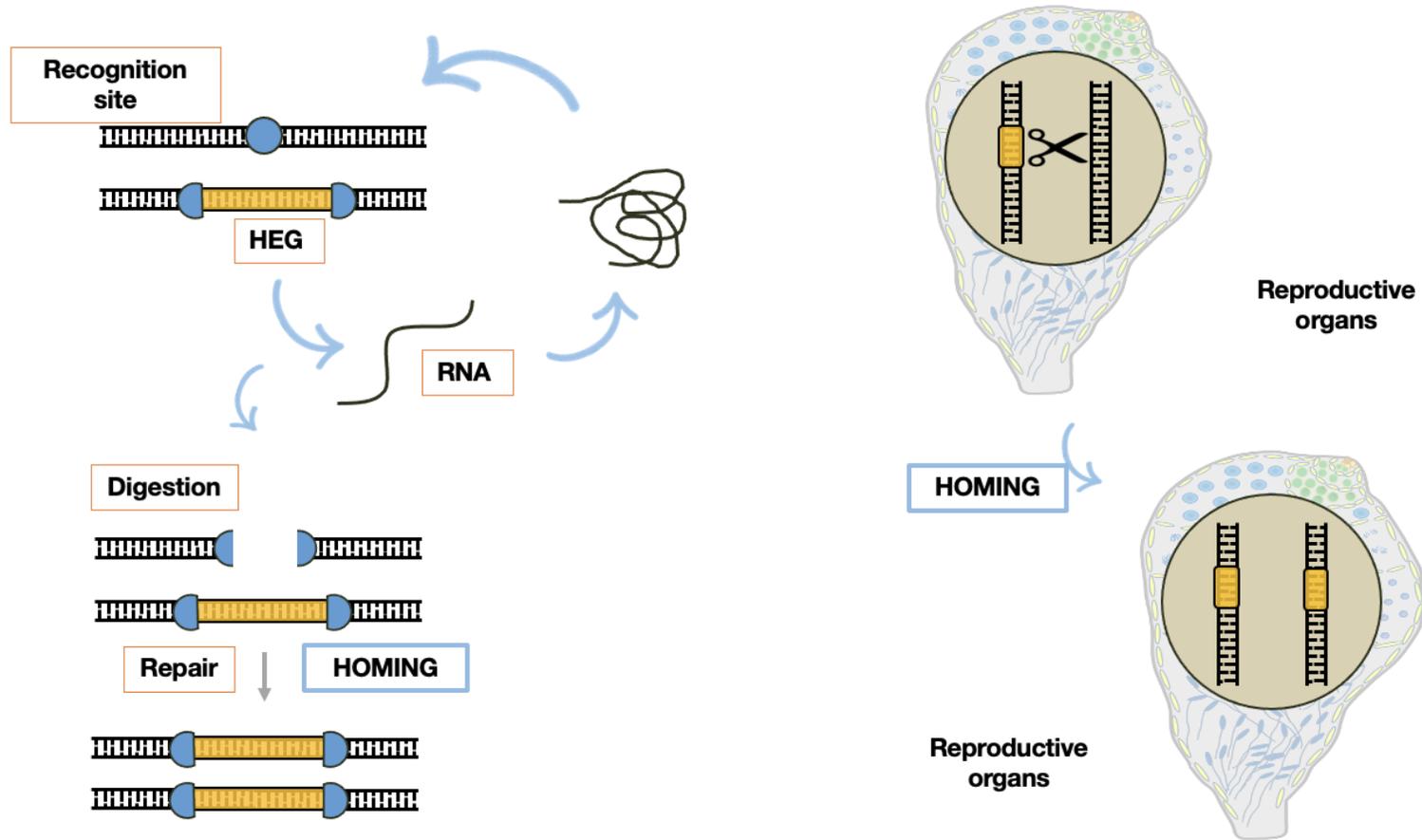
Mendelian Inheritance



Gene Drive Inheritance



How does a Gene Drive Work?



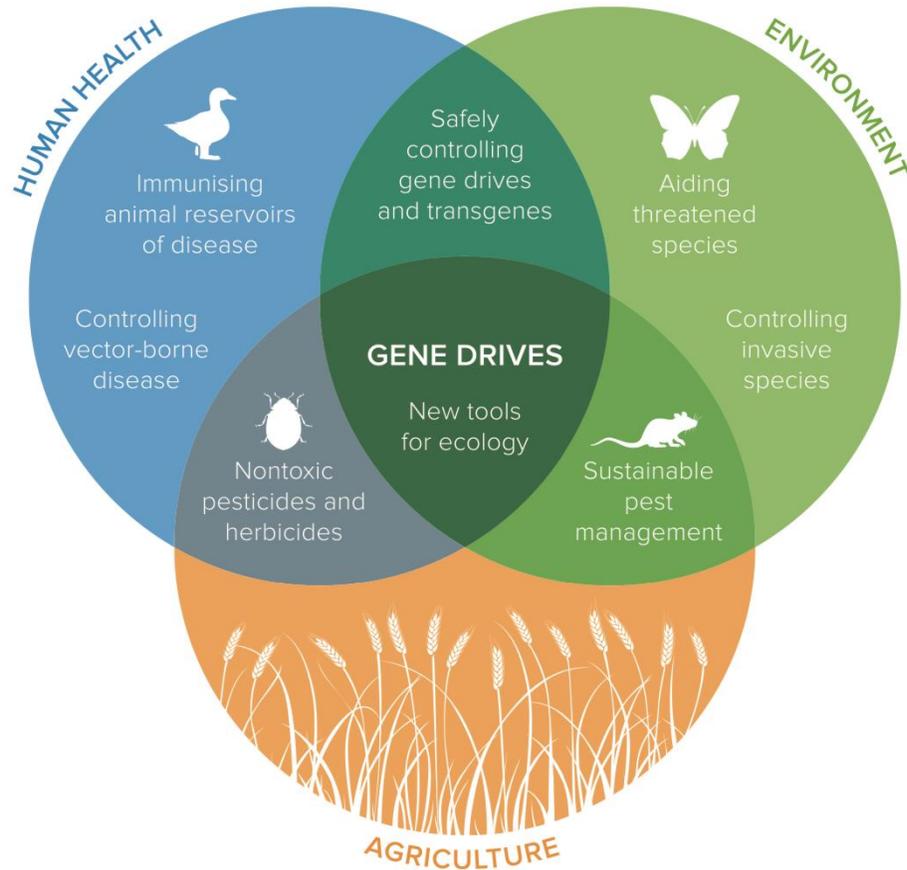
Gene Drive Systems Occurring in Nature

- Sex chromosome drive
- Transposable Elements
- Homing-based Gene Drive Elements
- Killer-rescue (e.g. MEDEA)
- Underdominance
- Cytoplasmic incompatibility (e.g. Wolbachia)

A good review: Champer et al. [Nature Reviews Genetics](#) **volume 17**, pages 146–159 (2016)

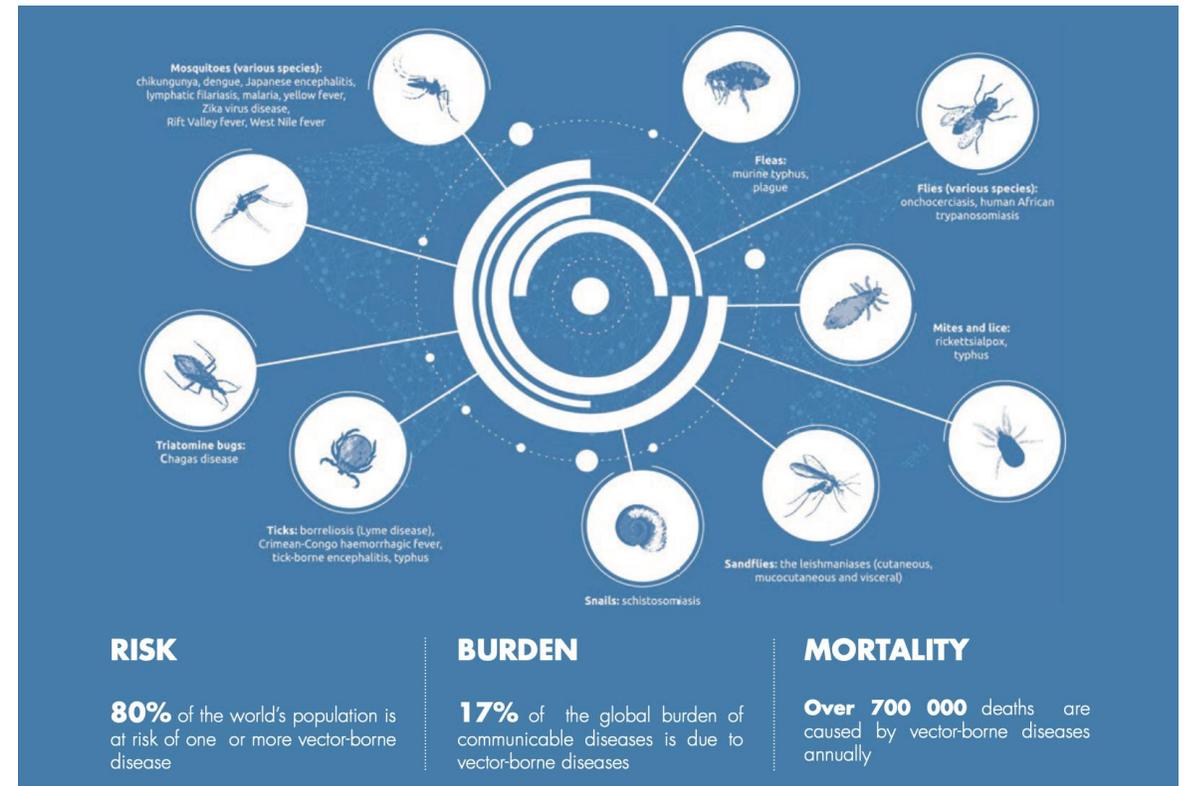


Current Applications of Gene Drives

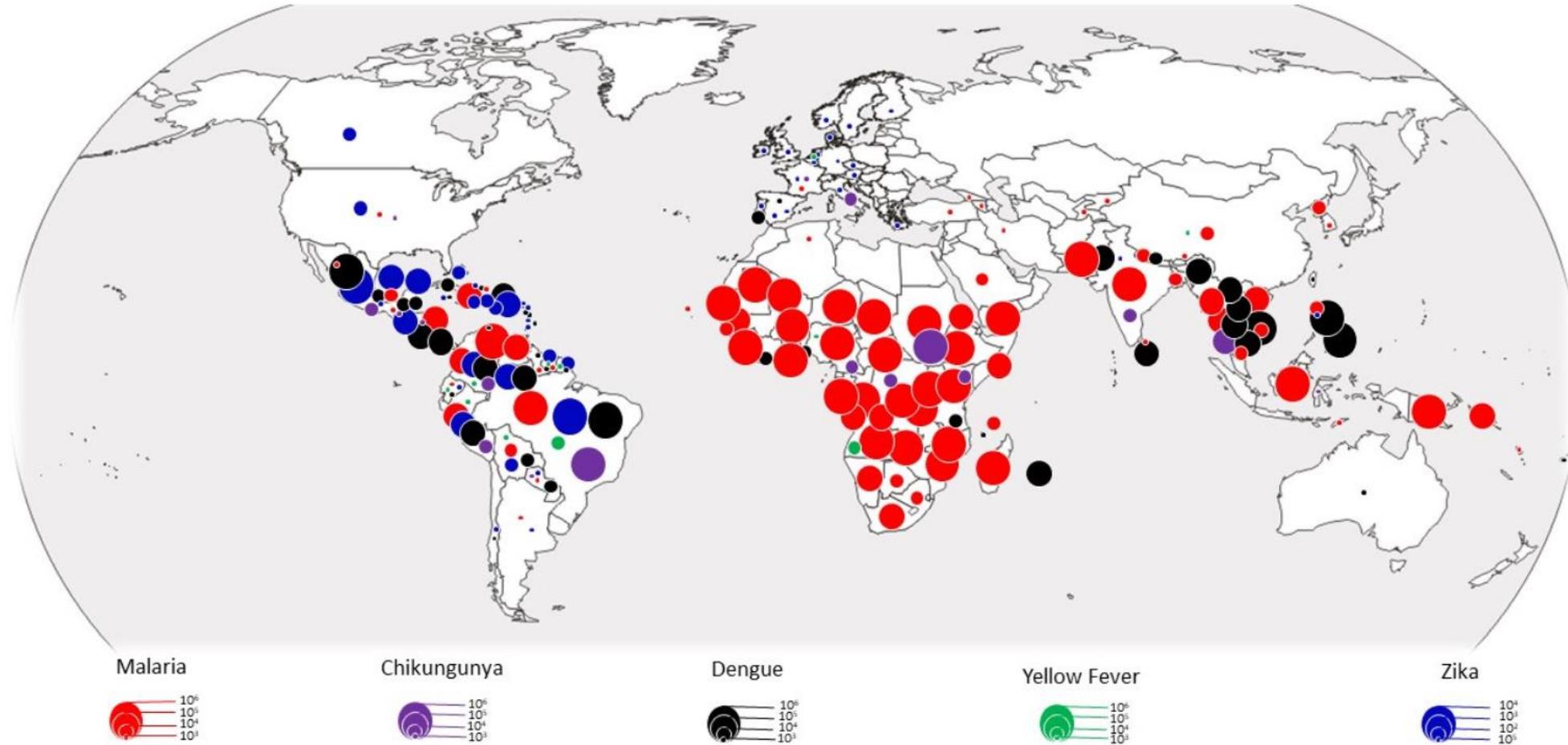


- Speculatively....many options:
- Most actively researched:
 - 1) Control of Invasive Alien Species
 - 2) Control of Vector-borne Diseases

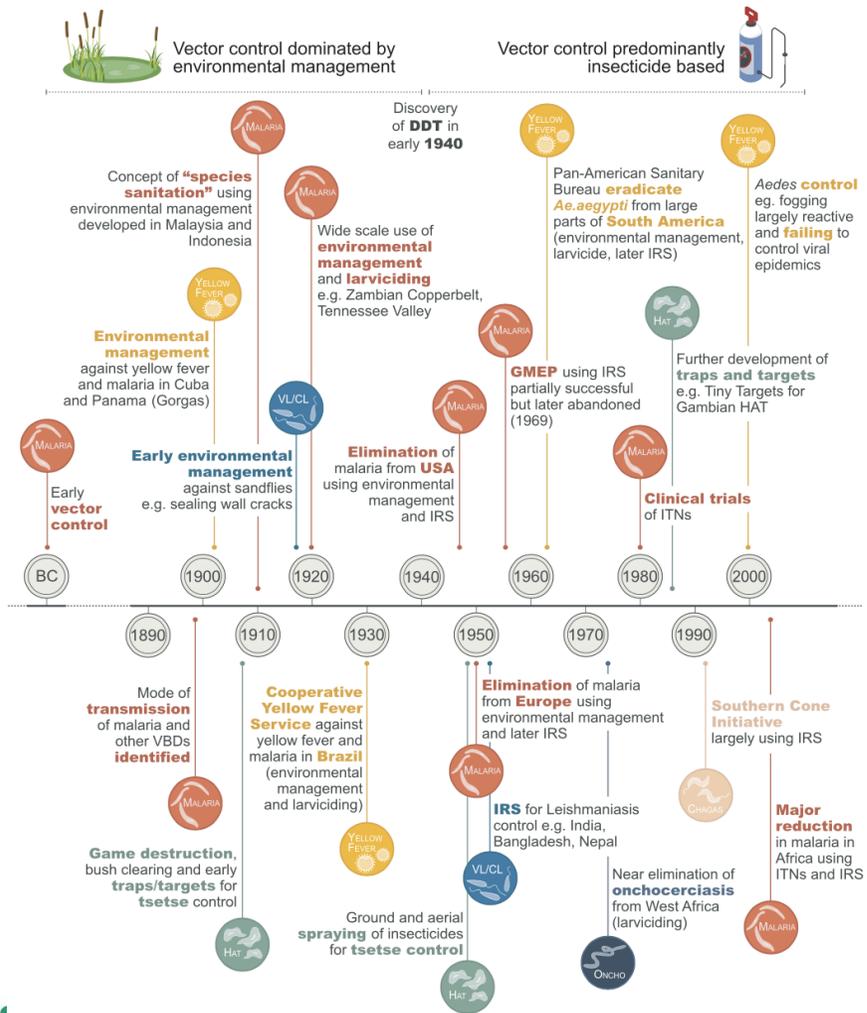
Burden of Vector-borne Diseases



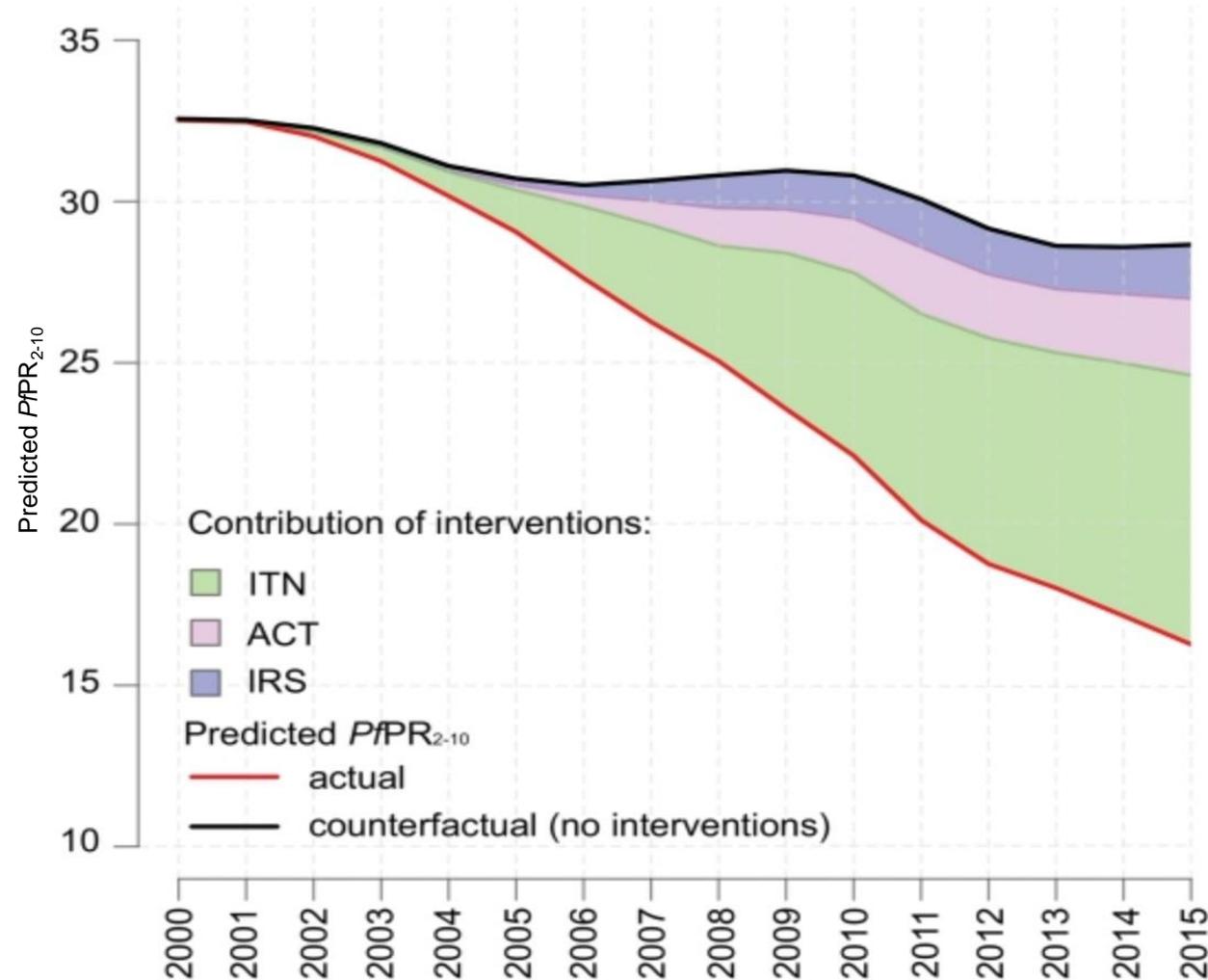
Global Distribution of Vector-borne Diseases



Vector Control Tools



Malaria Vector Control, 2000~15



(Partially) Successful Vector Control



Only active against those mosquitoes that bite indoors, at night

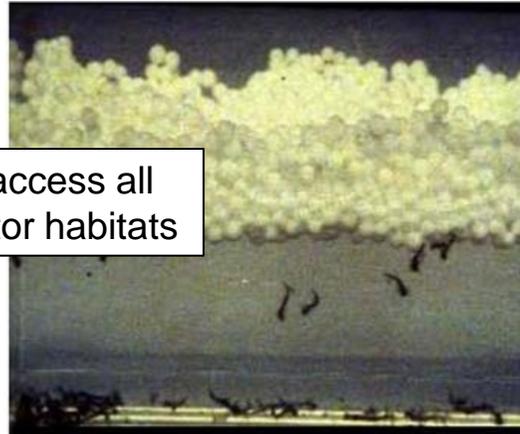


Lack of specificity – ecosystem damage

Insecticide Resistance



Difficult to access all types of vector habitats



Toxicity



What Makes Mosquitoes Good Vectors?

FACTORS:

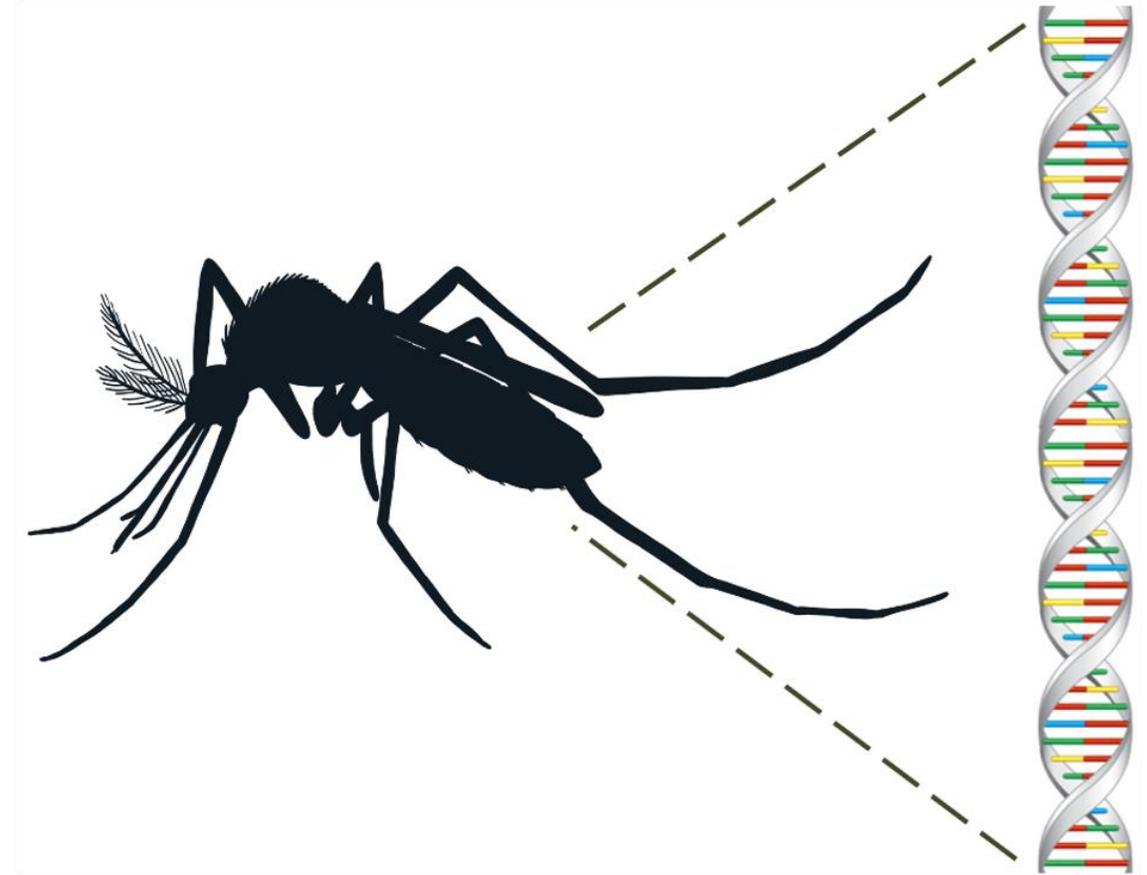
Host feeding behaviour
(human biting preference?)

Vector susceptibility
(immunity to parasite?)

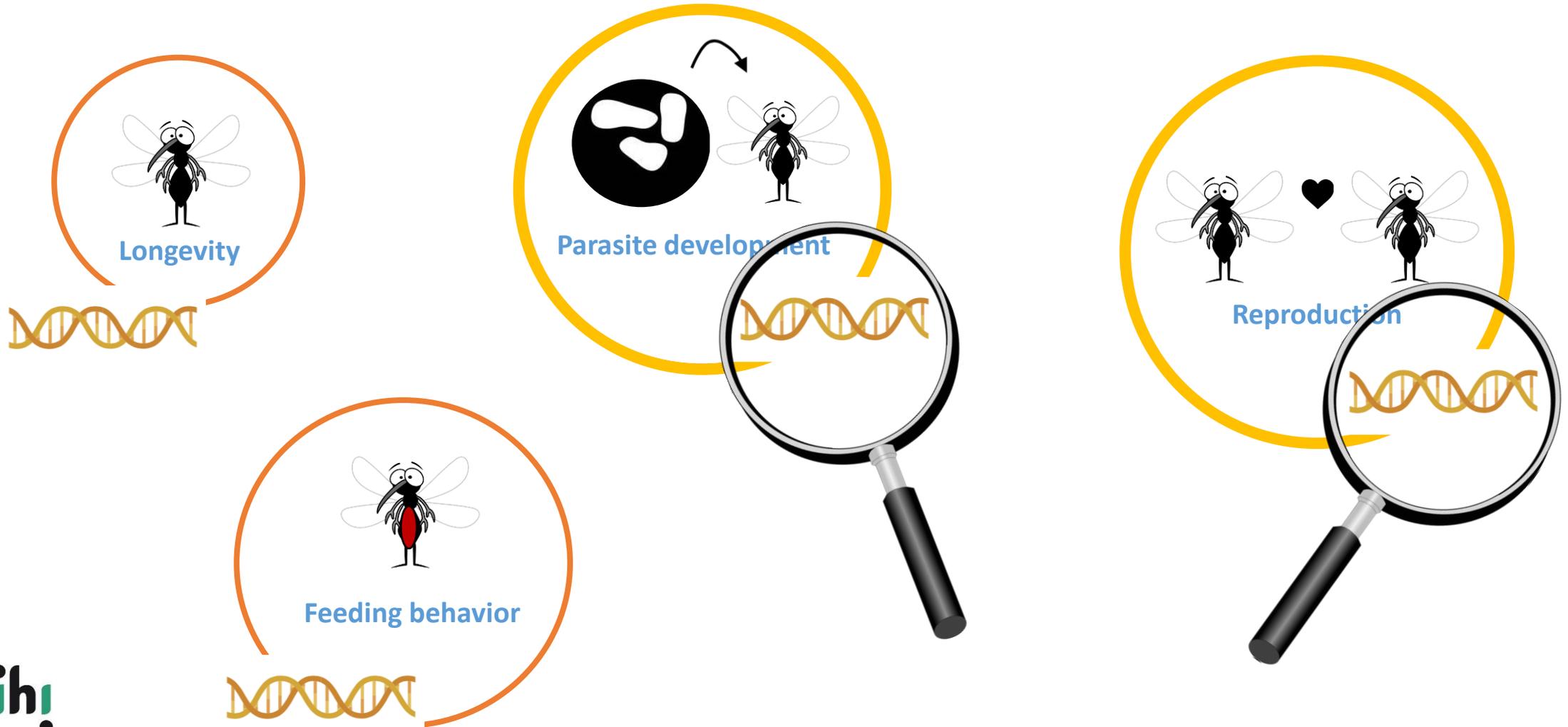
Vector longevity
(sufficient time for parasite to develop?)

Vector density
(high reproductive rate?)

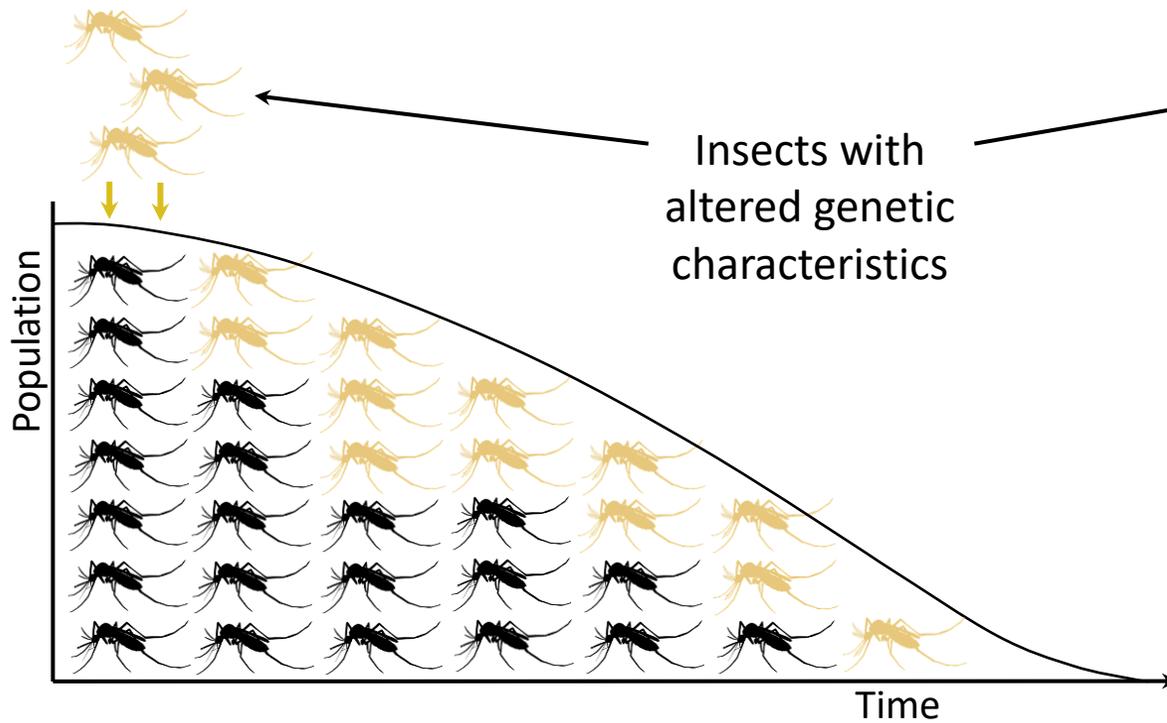
Habitat preference
(frequency of contact with human host?)
(preference for man-made habitats?)



Mosquitos' ability to transmit malaria is genetically determined....cont'd

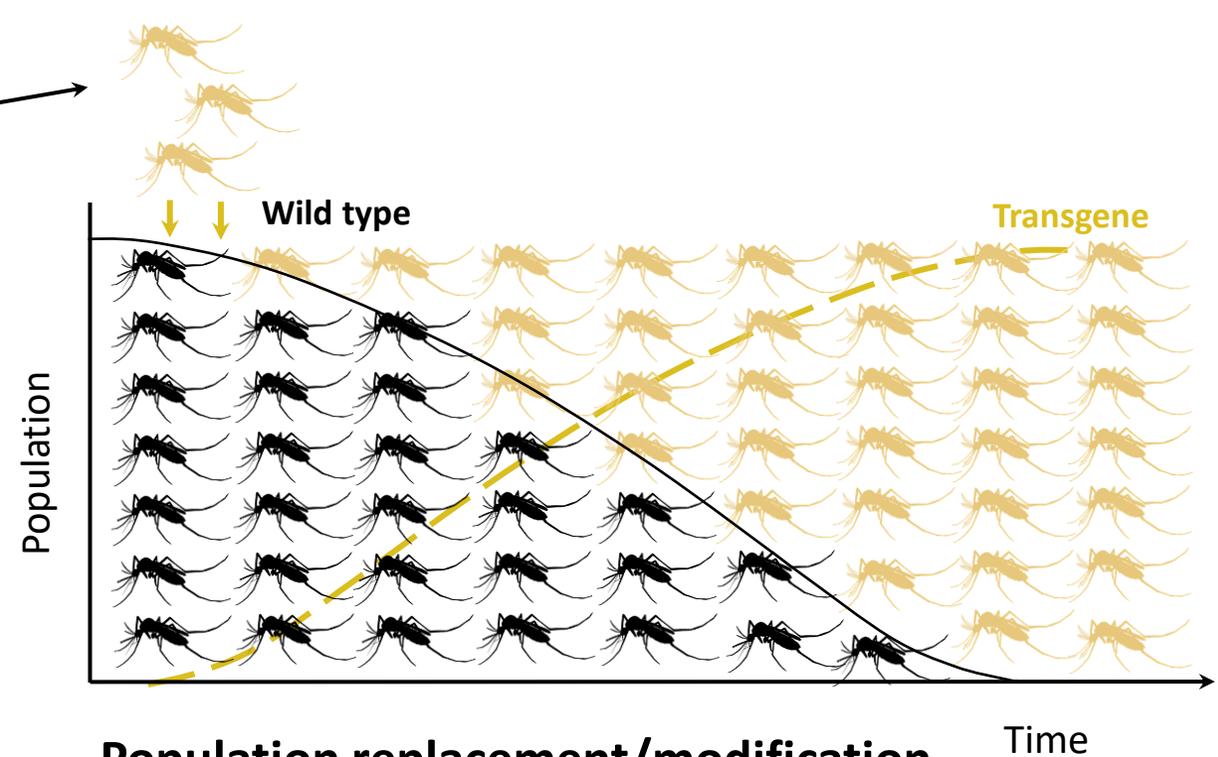


Genetic Control – Using Insects to do the Work



Population suppression

Elimination or reduction of a wild vector population



Population replacement/modification

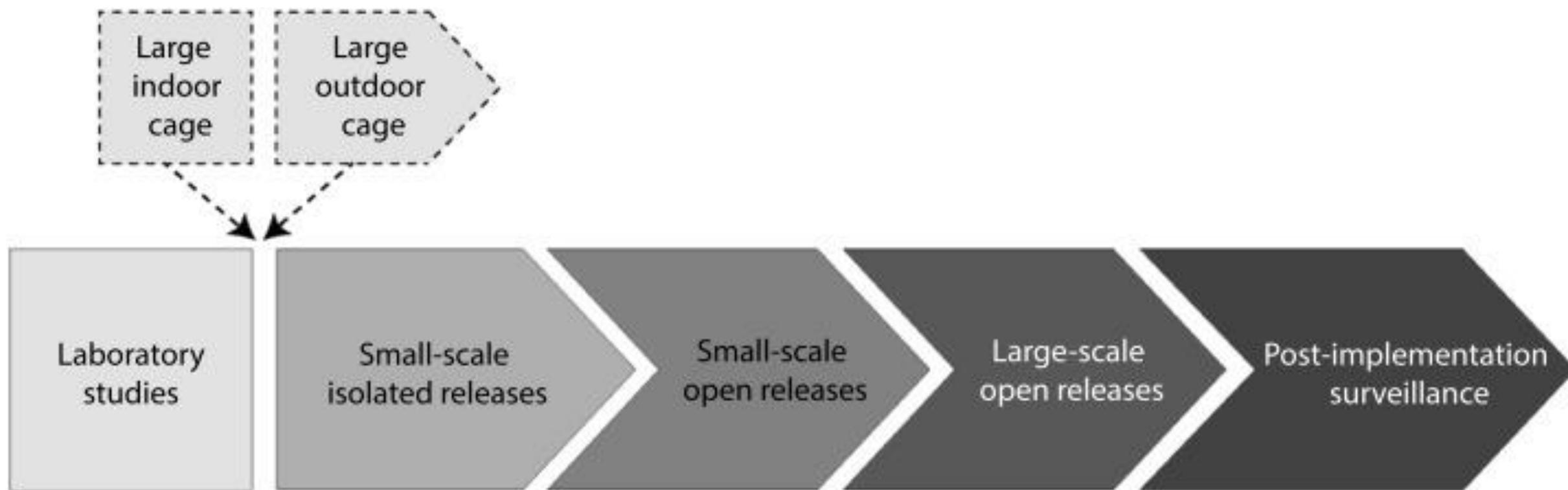
Replace a pathogen-susceptible vector population with pathogen-resistant insects

Questions Arising with Gene Drives

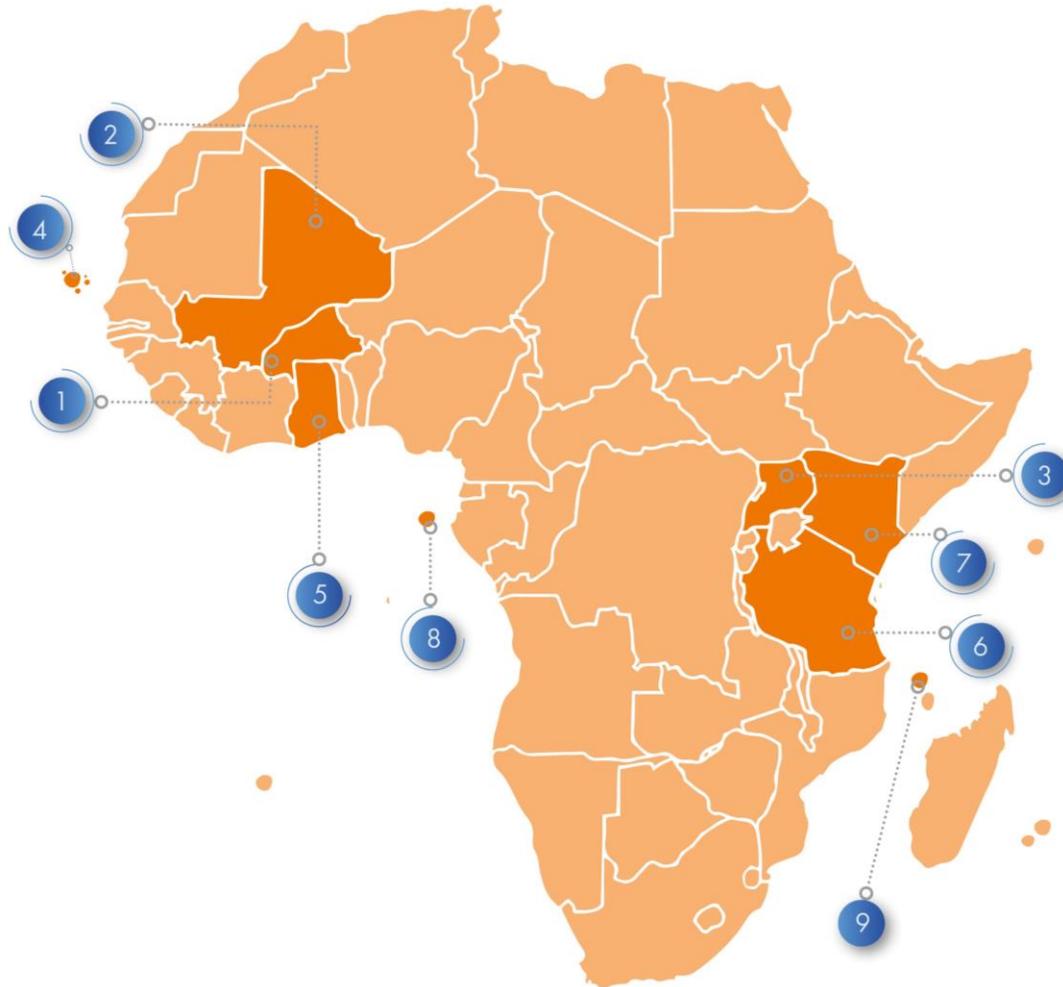
- Resistance
- Ecological and Biodiversity Effects
- Containment
- Community and Regulatory Acceptance



The phased pathway to deployment



Who works on Gene Drive Mosquitoes in Africa?



Works on gene drive mosquitos in Africa

-  **1** Burkina Faso
Mosquito suppression
-  **5** Ghana
Ecological
-  **2** Mali
Mosquito suppression
-  **6** Tanzania
Mosquito replacement
-  **3** Uganda
Mosquito suppression
-  **7** Kenya
Advocacy
-  **4** Carpe Verde
Mosquito suppression
-  **8** Sao Tome, Principe
Mosquito replacement
-  **9** Comoros
Mosquito replacement



Conclusion



Gene Drives have great potential for control of Vector-borne Diseases

