

# GM & GENE DRIVE MOSQUITOES: PRODUCT DEVELOPMENT PATHWAY

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RBM VCWG Expanding the Vector Control Toolbox

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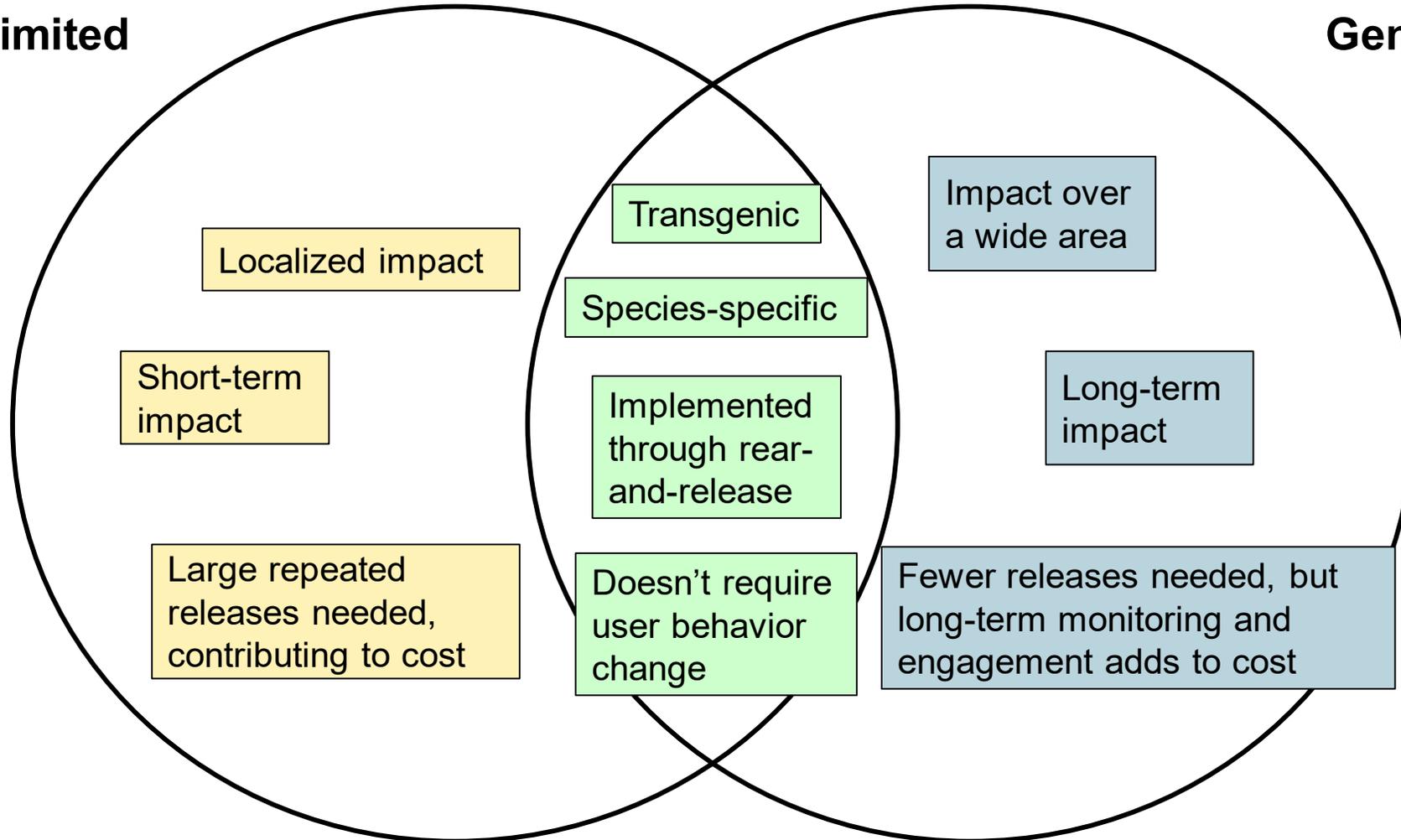
# DEFINITION OF PARADIGM/PRODUCT CLASS

	Genetically modified – self-limited	Gene drive
Product description	A mosquito strain that is modified so that only male offspring are produced	A mosquito strain that is modified with a construct that copies itself. The construct can either decrease mosquito populations (suppression) or make them unable to transmit malaria (replacement).
Potential impact	Localized	Widespread
Timespan	Transgenic mosquitoes die off after releases halt	Transgenic mosquitoes continue to increase and spread after releases halt
Intended use	<ul style="list-style-type: none"> <li>a) Malaria elimination in small foci</li> <li>b) Controlling urban malaria outbreaks</li> <li>c) Data from GM self-limited releases can contribute to decision-making on gene drive</li> </ul>	To drive down malaria transmission across widespread, rural, high-burden areas where current tools are insufficient to get to elimination
Timeline	More likely to be available in the next 5 years	10+ years

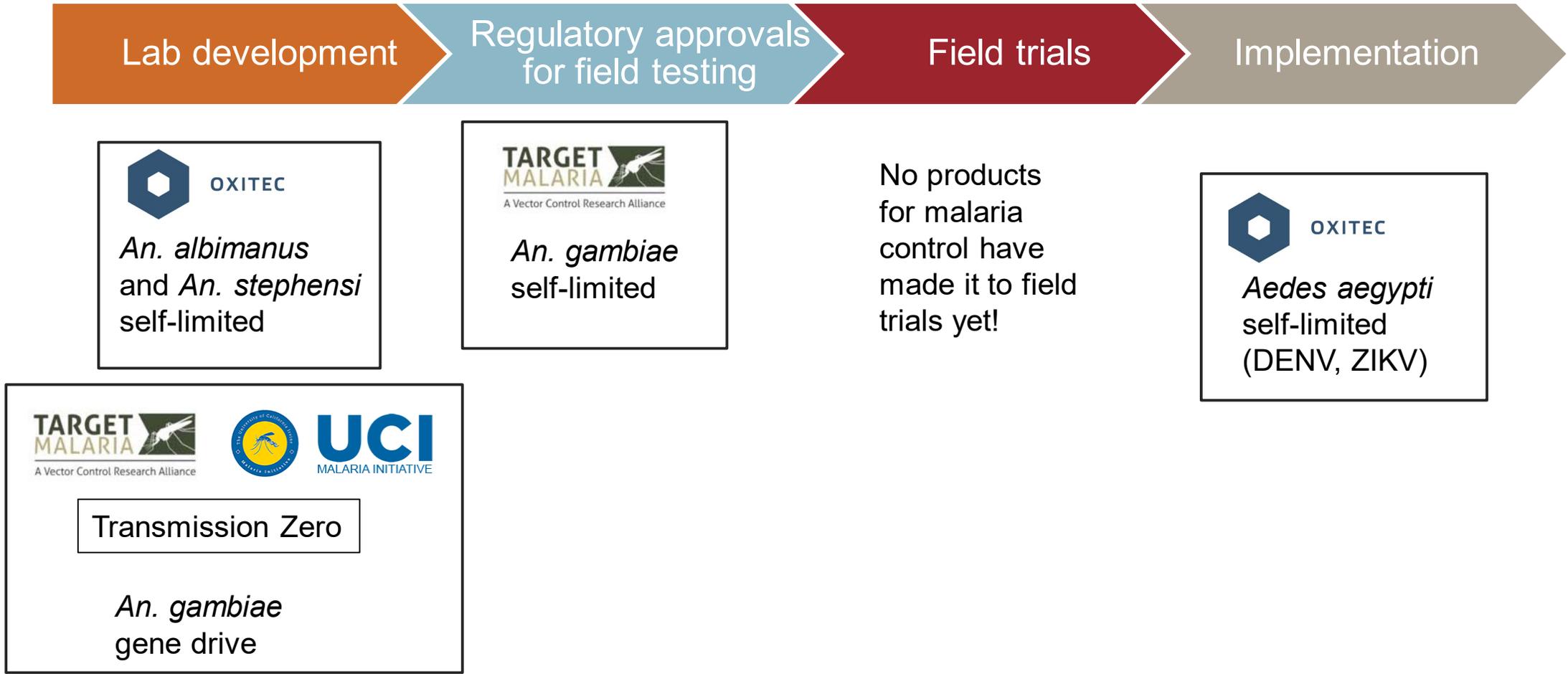
# DEFINITION OF PARADIGM/PRODUCT CLASS

**GM self-limited**

**Gene drive**



# PRODUCTS CURRENTLY UNDER EVALUATION

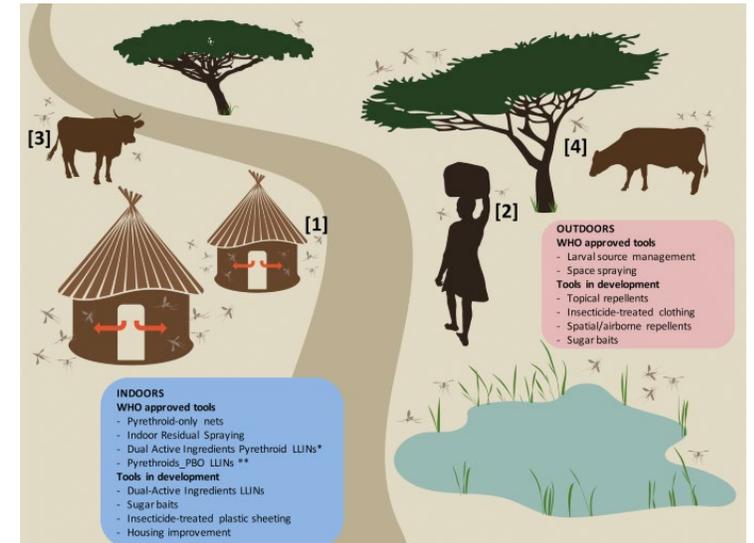
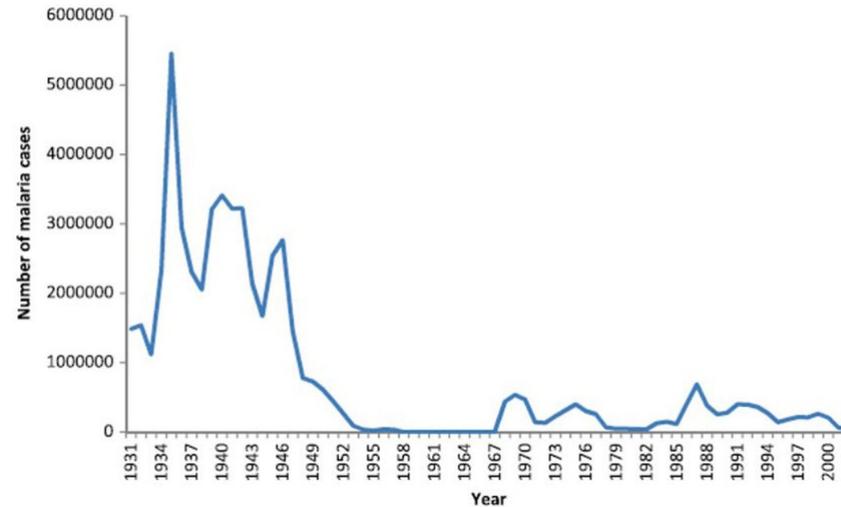
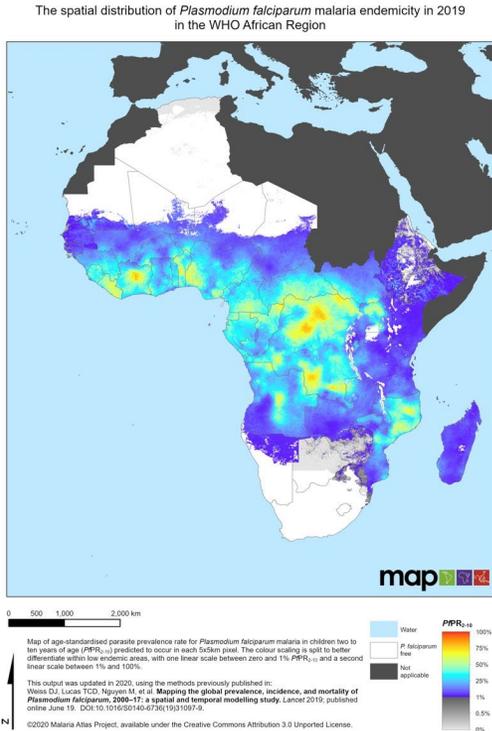


# GAPS THE PRODUCTS ARE MEANT TO ADDRESS

Regions with high transmission despite intervention scale-up

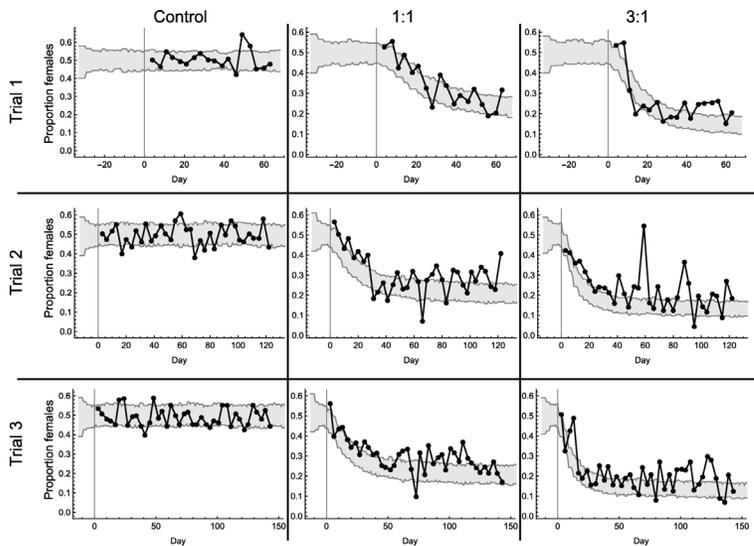
Outdoor biting

Elimination and prevention of reintroduction

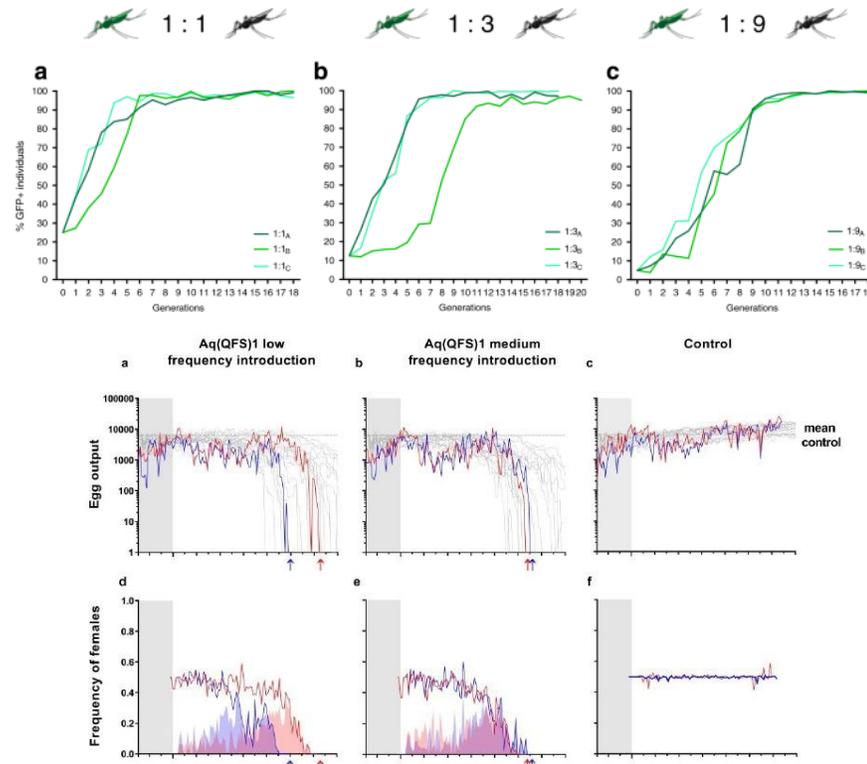


# ONGOING EVALUATIONS AND HIGH-LEVEL RESULTS

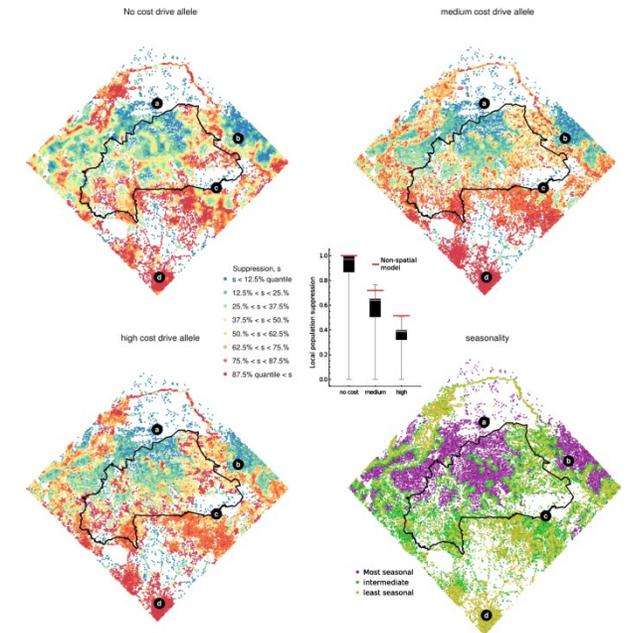
Lab dynamics of self-limited and modeling potential field impact: Facchinelli et al. 2019, Parasites & Vectors



Gene drive lab results: Adolphi et al. 2020, Nature Communications; Hammond et al., pre-print under consideration at Nature Portfolio



Modeling potential impact of gene drive: North et al. 2020, BMC Biology



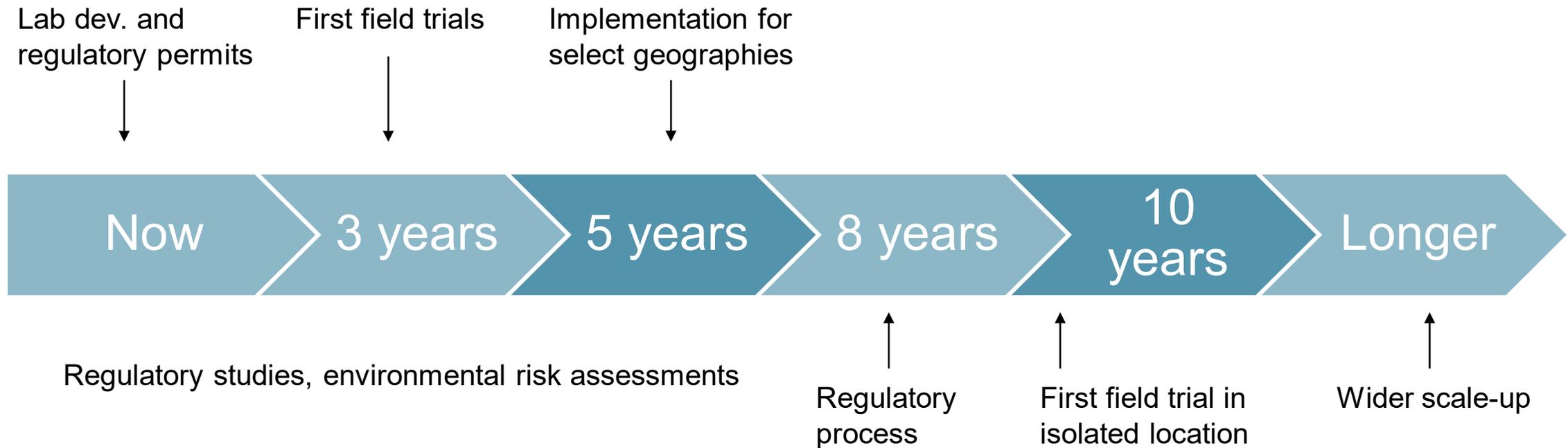
# REMAINING RESEARCH QUESTIONS TO BE ANSWERED

- Laboratory-based safety assays – Does the product pose any risks from toxicity, changes to vector competence, etc.?
- Laboratory-based efficacy tests – What factors might change the potential impact, and can those be mitigated?
- Ecological research questions – What are the potential impacts from mosquito suppression or niche replacement?
- Delivery – How to rear and transport *Anopheles* mosquitoes in sufficient numbers without harming fitness? What would a release network need to look like?
- Capacity and Ownership – How do we successfully transfer the technology to scientists and implementers in malaria-endemic countries?
- Trial design – How do you design a trial to evaluate public health impact, when a traditional RCT isn't possible?
- Evaluation – What data will be needed to make a decision on a gene drive release? What roles do national regulatory agencies, regional bodies, and WHO play?
- Engagement – What are the best ways to engage local communities in decision-making?
- Costs – What are the long-term costs, and cost efficacy?

# ESTIMATED TIMELINE TO MARKET

Note: these are estimated, best-case scenarios for a very uncertain new product timeline!

## GM self-limited



## Gene drive