

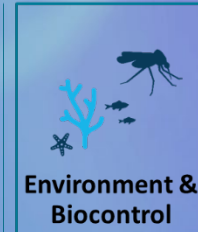


Regulatory & Policy Approaches to the Diversity of Gene Drives

Owain Edwards | 19 May 2022

Australia's National Science Agency

Synthetic Biology Future Science Platform





Regulatory Precedents



Australian Government
**Australian Pesticides and
Veterinary Medicines Authority**

**PERMIT TO ALLOW POSSESSION, SUPPLY AND USE OF
Wolbachia pipientis (wAlbB strain) BACTERIA
CARRIED BY *Aedes aegypti* MOSQUITOES**

PERMIT NUMBER –PER 84077



ORIGINAL RESEARCH
published: 22 March 2016
doi: 10.3389/fpubh.2016.00043



Risk Associated with the Release of *Wolbachia*-Infected *Aedes aegypti* Mosquitoes into the Environment in an Effort to Control Dengue

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¹CSIRO, Brisbane, QLD, Australia, ²Metro North Public Health Unit, Queensland Health, Brisbane, QLD, Australia

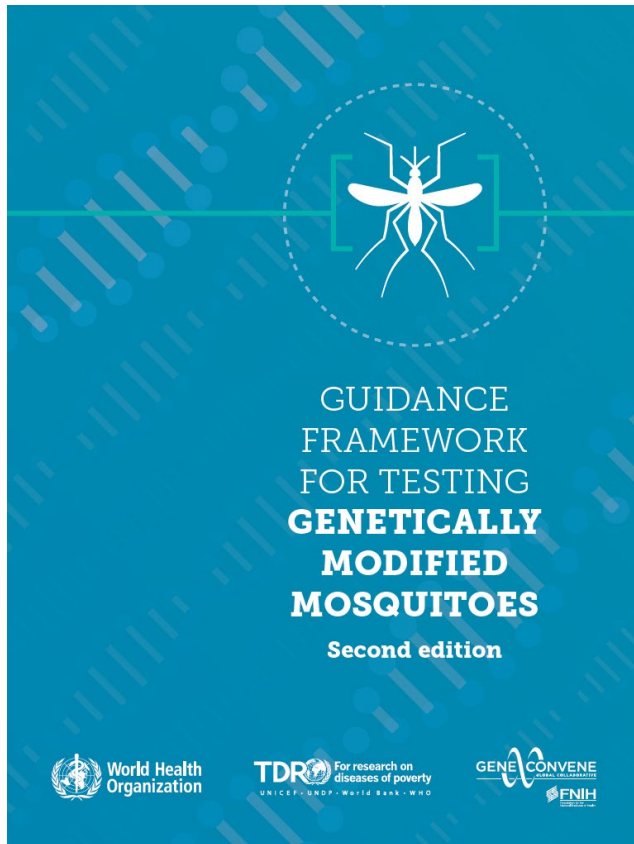


Learnings from Wolbachia regulatory assessment

1. Use existing generic risk assessment frameworks
2. Take advice from all available relevant guidelines
3. Engage with all stakeholder groups (Experts -> General Public) to identify gaps



Available Guidelines



A phased testing pathway is recommended, in which new GMM strategies move from the laboratory, to testing in more natural environments under confined conditions, and finally to open release trials, with each transition dependent upon satisfactory demonstration of efficacy and safety.



Fig. 1.3. Phased testing pathway for GMMs

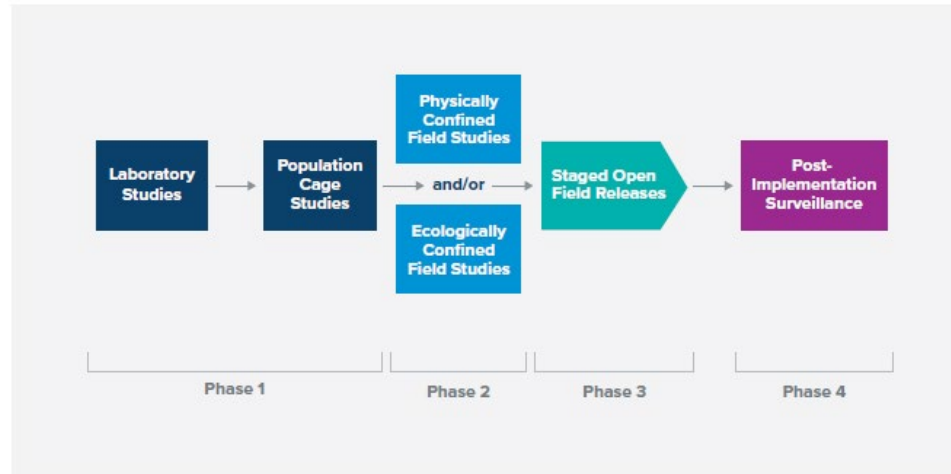
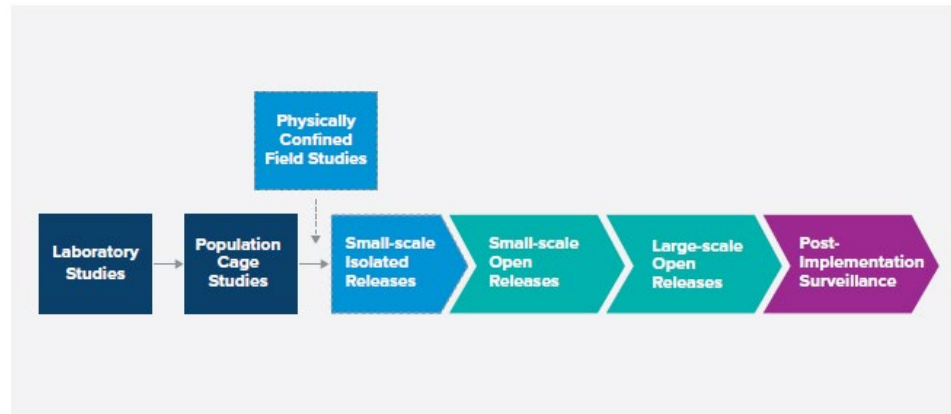


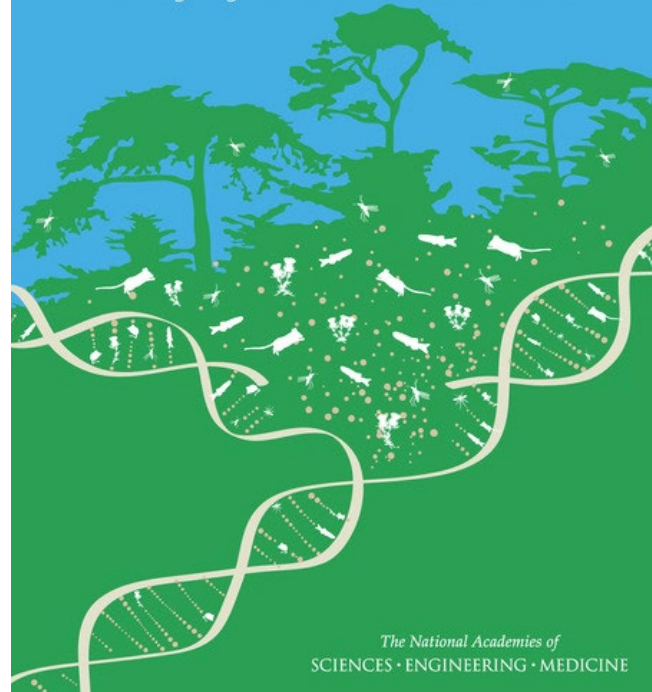
Fig. 1.4 Modified testing pathway for GMMs with low-threshold drive systems²





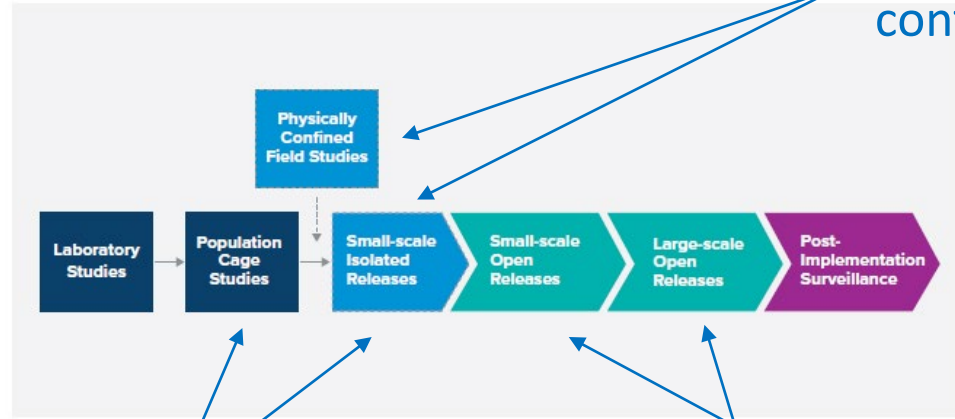
Gene Drives on the Horizon

Advancing Science, Navigating Uncertainty,
and Aligning Research with Public Values



The National Academies of
SCIENCES · ENGINEERING · MEDICINE

Fig. 1.4 Modified testing pathway for GMMs with low-threshold drive systems²

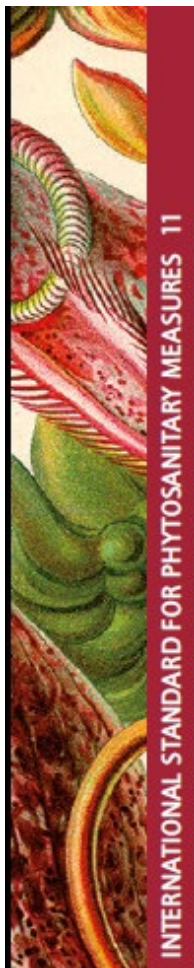


Ecological/Genetic containment

Validation of modelling

Technological steps:

1. Non-driving form
2. Drive without cargo/disruption
3. Split drive approaches
4. Genetic localization technologies



Food and Agriculture
Organization of the
United Nations



International Plant Protection Convention
Protecting the world's plant resources from pests

ISPM 11

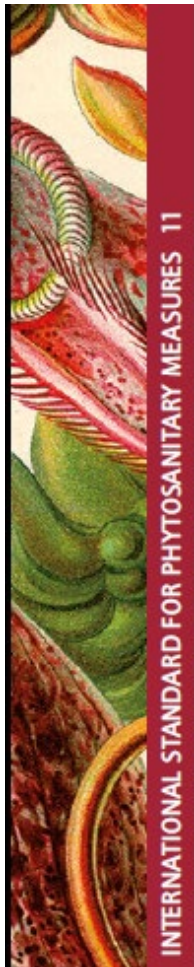
ENG

Pest risk analysis for quarantine pests



STAGES of PEST RISK ANALYSES

1. Probability of Introduction (species or genotype/phenotype)
2. Probability of Establishment (and Spread)
3. Potential Economic/Environmental Consequences
4. Pest Risk Management



Food and Agriculture
Organization of the
United Nations



International Plant Protection Convention
Protecting the world's plant resources from pests



ANNEX 2: Pest risk analysis for living modified organisms (LMOs)



Pest Risk Analyses of LMOs

- Useful to consider risks relative to unmodified organism
- Direct effects: altered pest characteristics
- Indirect effects: quality/prevalence of other species due to effects of modification



Stakeholder Consultation



ORIGINAL RESEARCH
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Connolly et al. *Malar J* (2016) 15:170
<https://doi.org/10.1186/s12936-021-03674-6>

Malaria Journal

RESEARCH

Open Access

Systematic identification of plausible pathways to potential harm via problem formulation for investigational releases of a population suppression gene drive to control the human malaria vector *Anopheles gambiae* in West Africa



John B. Connolly^{1*}, John D. Mumford², Silke Fuchs¹, Geoff Turner¹, Camilla Beech³, Ace R. North⁴ and Austin Burt¹

Risk Associated with the Release of *Wolbachia*-Infected *Aedes aegypti* Mosquitoes into the Environment in an Effort to Control Dengue

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ADDITIONAL STEPS FOR GENE DRIVE ORGANISMS?

- Probability of spread after establishment into other regulatory jurisdictions

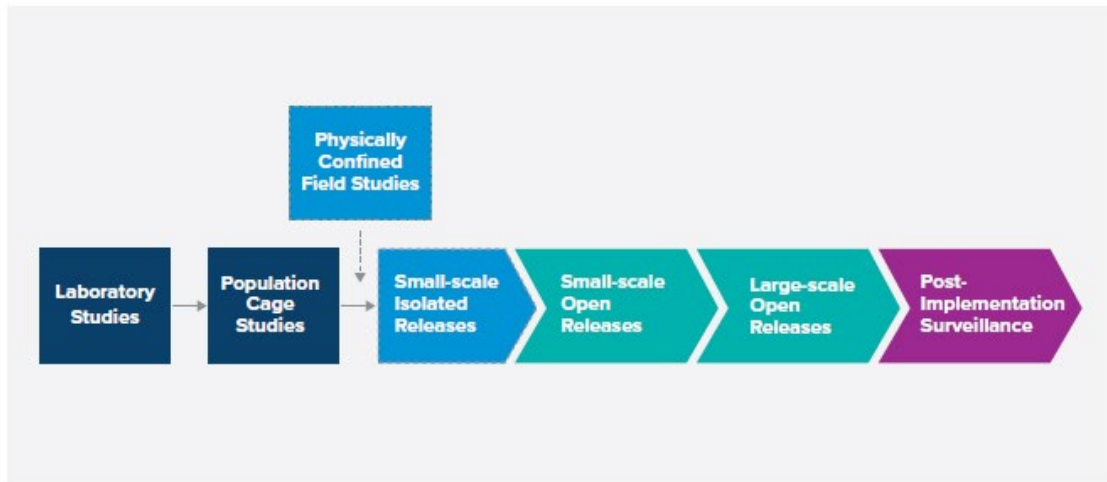


Convention on
Biological Diversity

**Cartagena
Protocol
on
Biosafety**



Fig. 1.4 Modified testing pathway for GMMs with low-threshold drive systems²



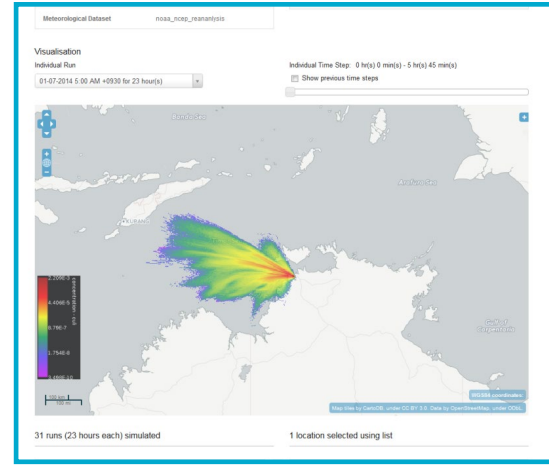
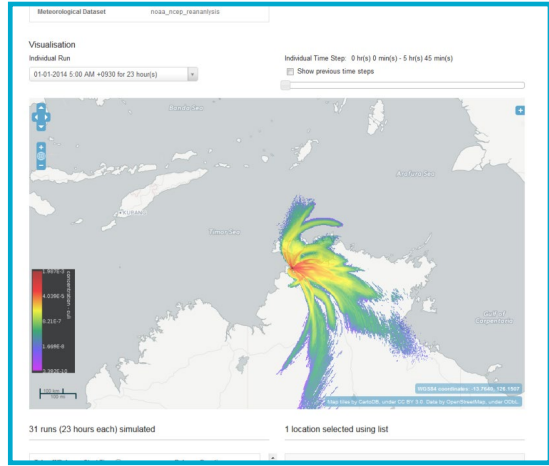
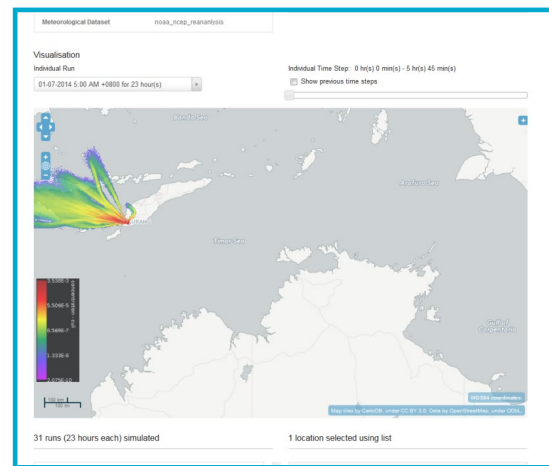
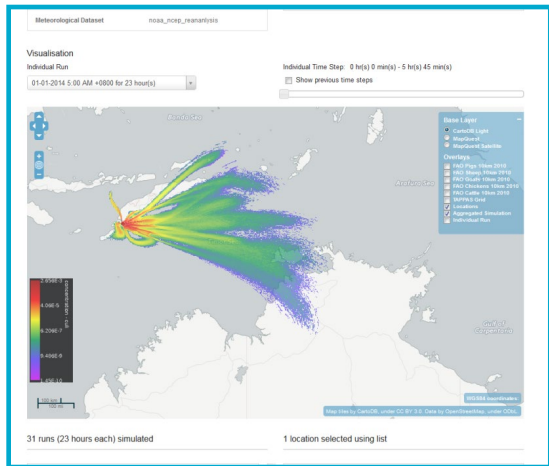


MODELLING MOVEMENT of INVASIVE SPECIES

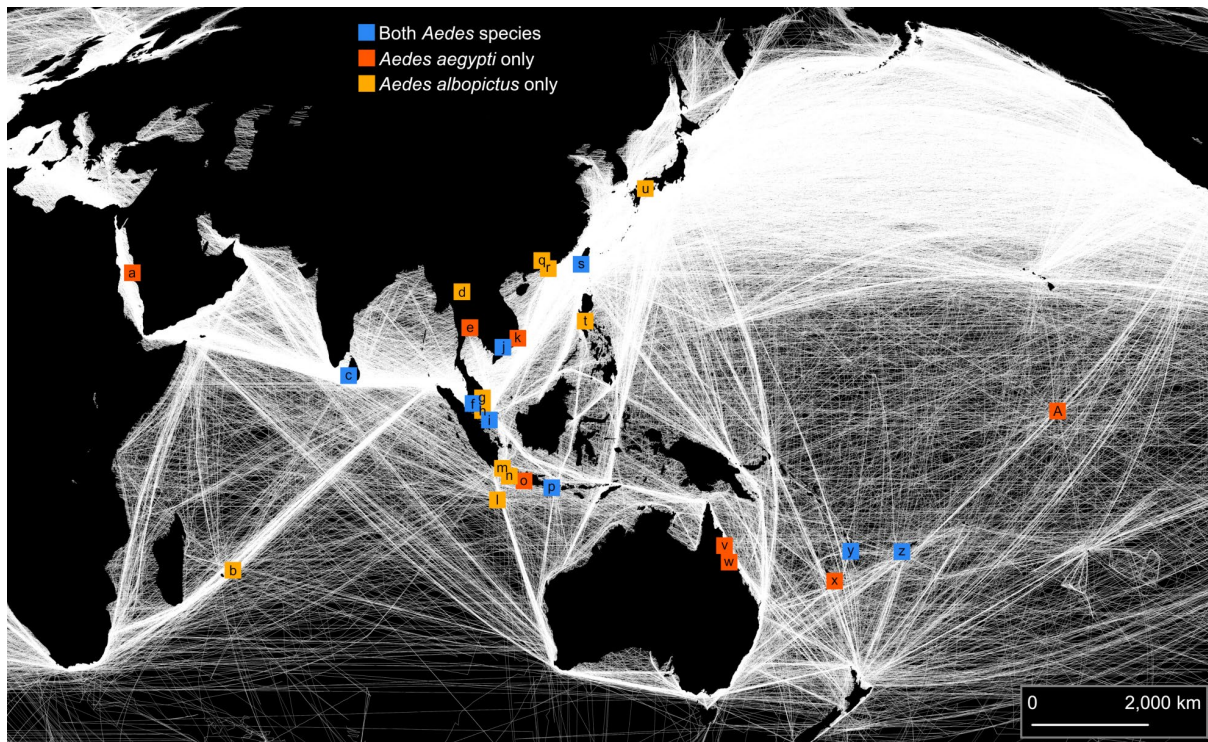
1. Natural (wind-borne) movement
2. Human-assisted movement



TAPPAS (Tool for Assessing Pest & Pathogen Aerial Spread)



ASIAN-PACIFIC SHIPPING LANES



Schmidt et al. (2020)



GENOMIC ASSESSMENTS OF FRUIT FLY INCURSIONS





GENOMIC ASSESSMENTS OF FRUIT FLY INCURSIONS





TAKE HOME MESSAGES

1. To cover the diversity of gene drives, use an established, generic, case by case regulatory assessment approach
2. Take advice from published guidelines and by engaging all relevant stakeholders
3. Field releases should be staged not just by scale (small -> large) but also by technology (non-drive, drive with no cargo, split drive, etc.)
4. Likelihood of spread between jurisdictions after establishment should be examined in depth for gene drive organisms