

# National Malaria Control Forum 2011

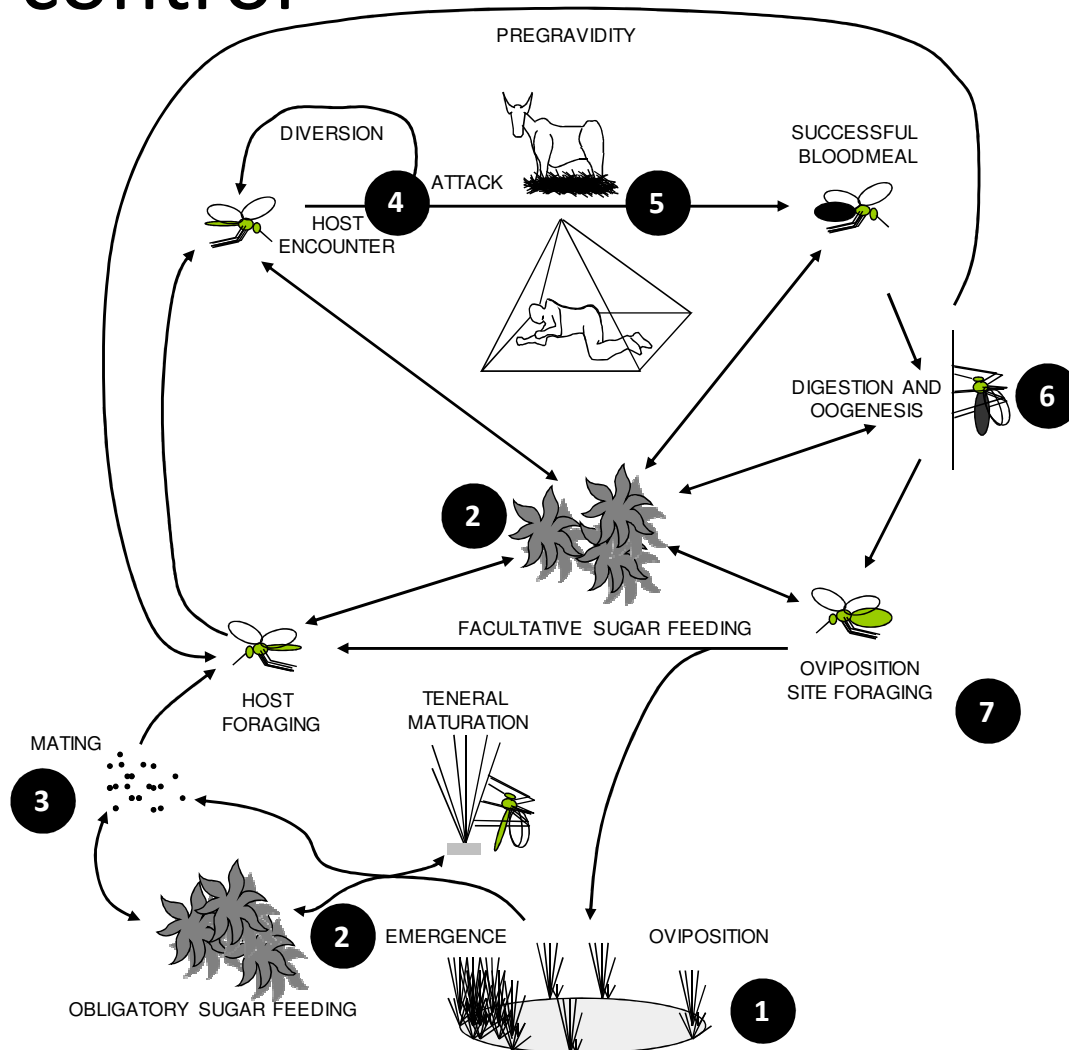
**Vector Control/Ecology**

**NEW DEVELOPMENTS IN VECTOR  
CONTROL**

# Focus for new research and development in vector control

- ITNs and IRS are doing a great job, but they need to be complemented:
  - How do we tackle the remaining/residual transmission?
  - How do we adapt to the changing behavior of mosquitoes?
  - How do we control outdoor biting mosquitoes?
  - How do we deal with *An. arabiensis* which can use multiple blood sources?

# Many areas of the life cycle can be tackled for malaria control



Ferguson et al. (2010) PLoS Med 7(8)

- 1 Environmental management and larvicide application by direct means or by autodissemination via adults
- 2 Insecticide and paratransgenic bacteria application to natural sugar sources as well as toxic sugar baits
- 3 Pheromone trapping and release of genetically modified or sterile males
- 4 Repellents, physical barriers
- 5 Zooprophylaxis, insecticide-treated cattle and odor-baited traps
- 6 Adult contamination with biological and chemical agents which may be autodisseminated,
- 7 Environmental management forcing increasing foraging mortality

# Strategies to complement ITNs and IRS

- Prevent mosquitoes from getting into houses (House improvement)
- Reduce mosquitoes at their source (Environmental Management, Larviciding)
- Reduce human-mosquito contact (repellents, attract and kill, entomopathogenic fungi, zooprophylaxis)
- Manipulate mosquitoes (Sterile Insect Techniques, Genetically Modified Mosquitoes)

# House improvement

What has been done about this, 108 years on???



Celli 1901.



Kirby et al 2009

# House improvement

T "N" GROOVE



GYPSUM



- People are aware of the benefits of screening or installing ceilings to houses including preventing mosquitoes from getting in

- Affordability is the reason for not having screened houses



# Environmental Management

LUANSHAYA RIVER, ZAMBIAN COPPER BELT (MAY 1930)



# LUANSHAYA RIVER, ZAMBIAN COPPER BELT

AUGUST 1930





# Larviciding



Challenge with conventional larviciding: **targeting** the most productive sites for cost-effectiveness of the operation





Bumbwini



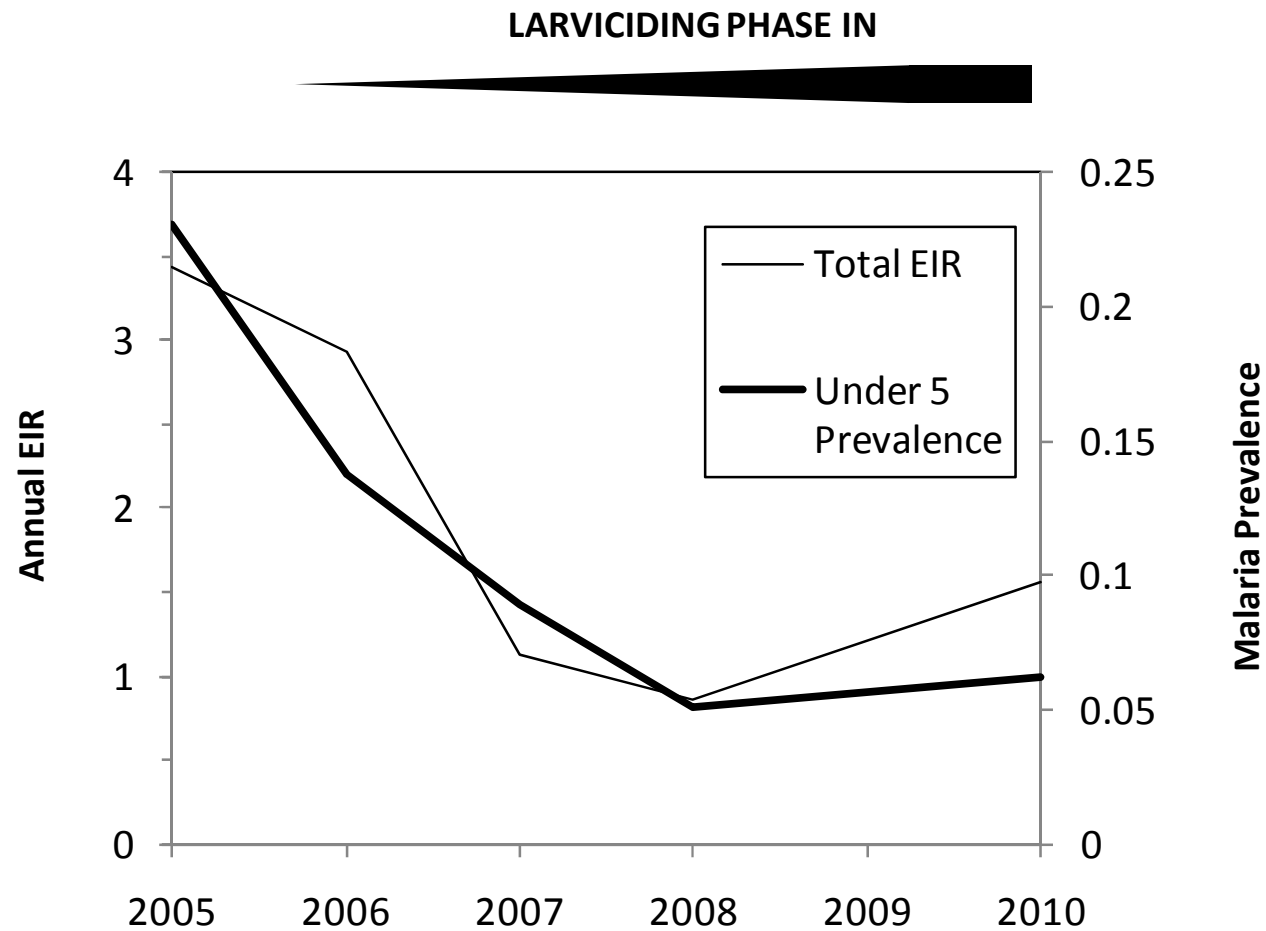
Jendele



Bumbwini



Jendele

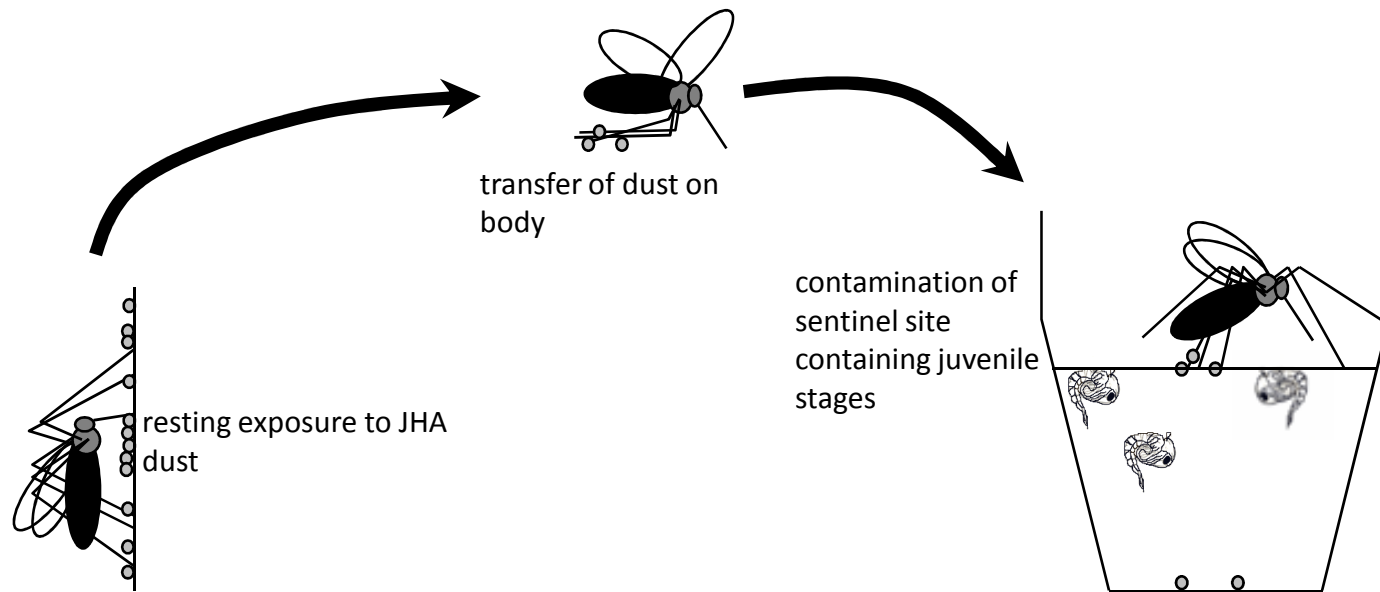


**Figure 4.** Association of larviciding roll out with declining transmission and prevalence in Dar es Salaam<sup>2</sup>.

Courtesy G. Killeen

# Control of juvenile stages

Auto-dissemination of Pyriproxyfen(JHA) in breeding sites by adult mosquitoes (mothers killing their own babies!!!)





# Repellents:

On individuals, on mats, on sheets, around resting areas, etc.



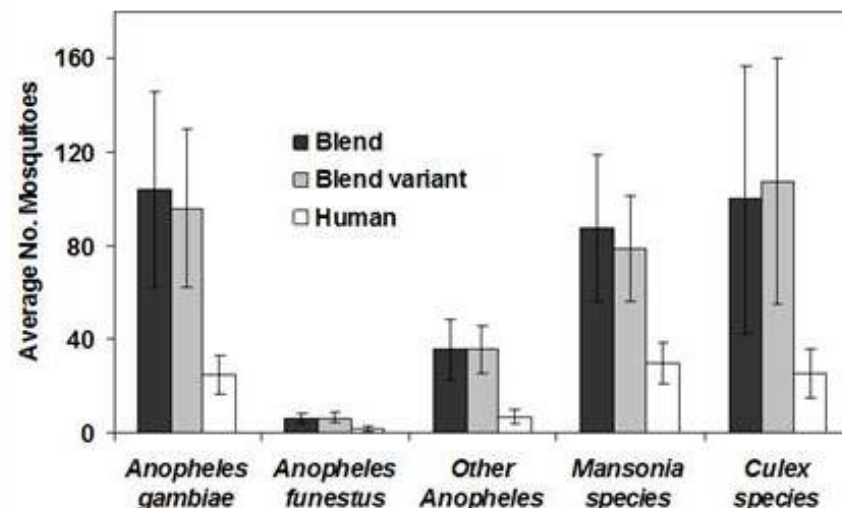
Roberts, Achee & Greico



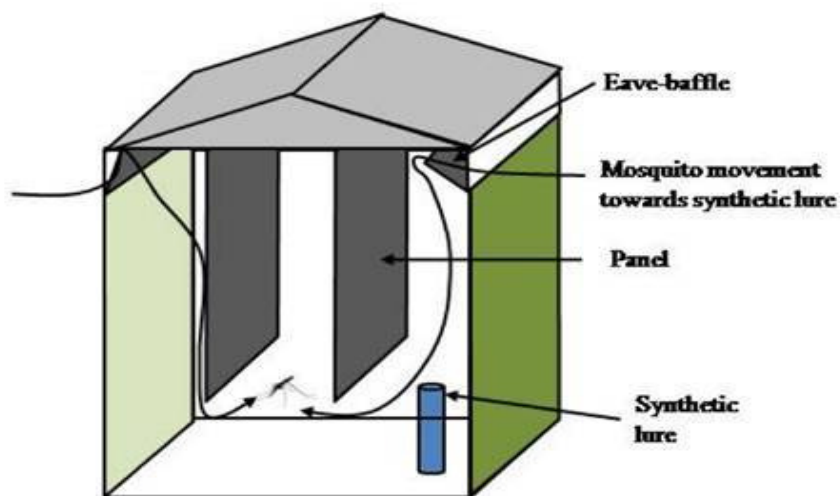
# Odour-baited traps for malaria control



**A**



**B**



Attract and kill  
or attract and  
use to  
disseminate  
insecticides

Okumu et al 2010 Parasites & Vectors 3: 12

Lwetoijera et al 2010 Parasites & Vectors 3: 18

Okumu et al 2010 PLoS One 5: 8951

# Entomopathogenic fungi for malaria control



- Fungi can infect and kill mosquitoes
- Mass release of fungi will affect mosquito populations and reduce risk of malaria transmission

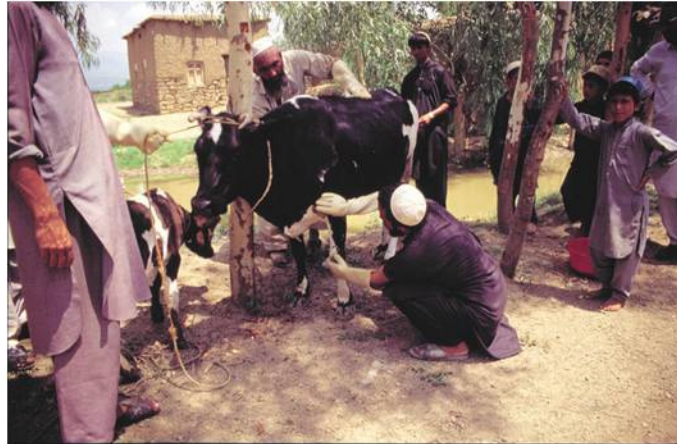
Courtesy L. Mnyone, IHI

# Entomopathogenic fungi for malaria control



- Up to 75% of house entering mosquitoes can be infected with fungus
- model estimates: fungus alone can reduce EIR by  $>75\%$ .

# Insecticide treated cattle for malaria control



- Reduction in number of mosquitoes biting humans in villages with cattle (Valeriana et al, submitted ).
- ITNs could divert mosquitoes away from humans to feeding on cattle (Issa et al, submitted ).
- Model predicted that ITC can provide reduction of malaria transmission of up to 60%
- Insecticide treatments on cattle may therefore reduce the risk of outdoor transmission of malaria

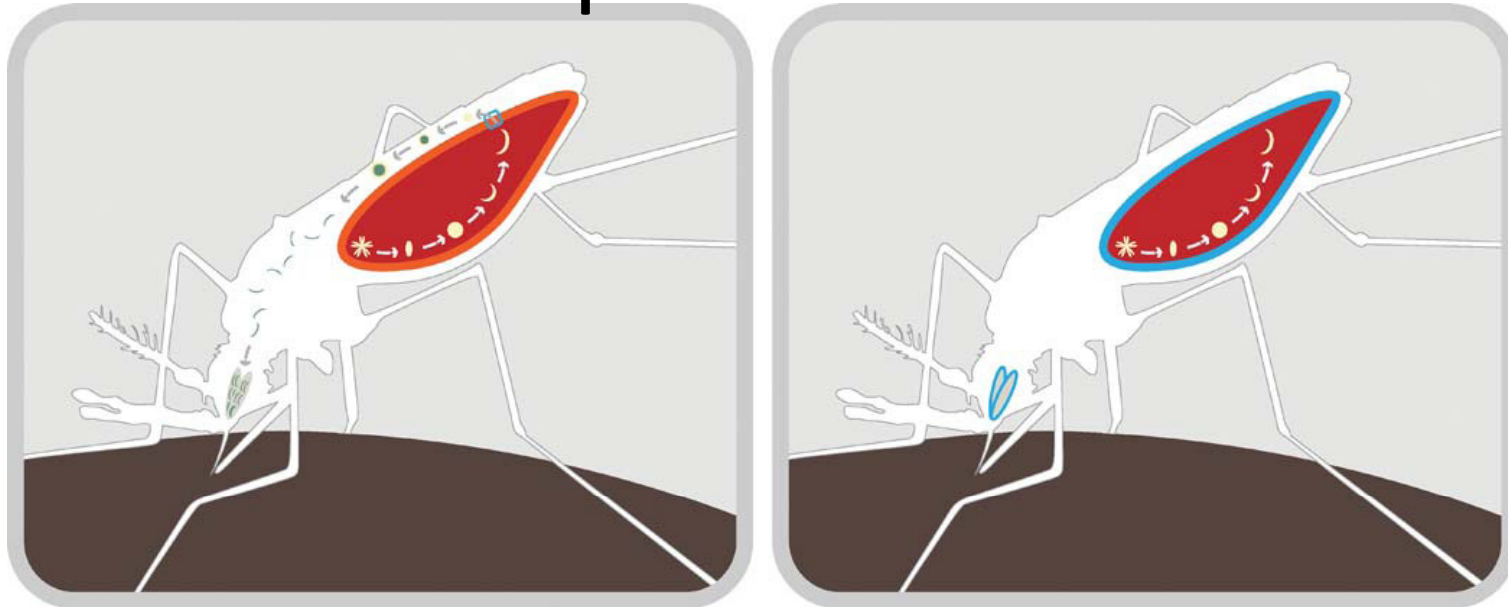
Courtesy I. Lyimo, IHI

# Zooprophylaxis

- Establish what type of insecticide commonly applied on cattle could provide community protection by massive killing of mosquitoes.
- Assessing whether insecticides commonly used on cattle might repel mosquitoes and increase risk of malaria transmission.
- Testing other treatments of cattle (e.g. ivermectin, entomopathogenic fungi, pyriproxyfen, and non-pyrethroids) on killing mosquitoes.



# Sterile Insect Technique and Genetically Modified Mosquitoes for malaria control



Marshall and Taylor 2009

- Sterile insect technique (SIT)- Induce sterility into wild population and reduce vector population size.
- Genetically modified mosquitoes (GMM) – Introduce parasite refractory gene and block parasite transmission among wild vector populations

Courtesy K. Ng'habi, IHI

# SIT and GMM for malaria control



- The two techniques require sufficient knowledge and expertise on the ecology and biology of target vector species. e.g. reproductive fitness, population size and structure.
- These techniques should be tested first in large semi-field systems prior to field implementation

Courtesy K. Ng'habi, IHI

**Thank You**