

Breaking the transmission cycle of Dengue Virus

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Interrupting the transmission cycle

- Vector control
 - Source reduction
 - Larviciding
 - Adulticiding
 - Biocontrol
 - (DDT)



- Transmission control
 - Bednets, DEET, odorant disruption, prophylactics, disease eradication.

<http://phil.cdc.gov/phil/home.asp>

Interrupting the transmission cycle

- Mosquito control
 - Source reduction
 - Larviciding
 - Adulticiding
 - Biocontrol
 - (DDT)



- Preventing transmission
 - Bednets, DEET, odorant disruption, prophylactics, **disease eradication.**

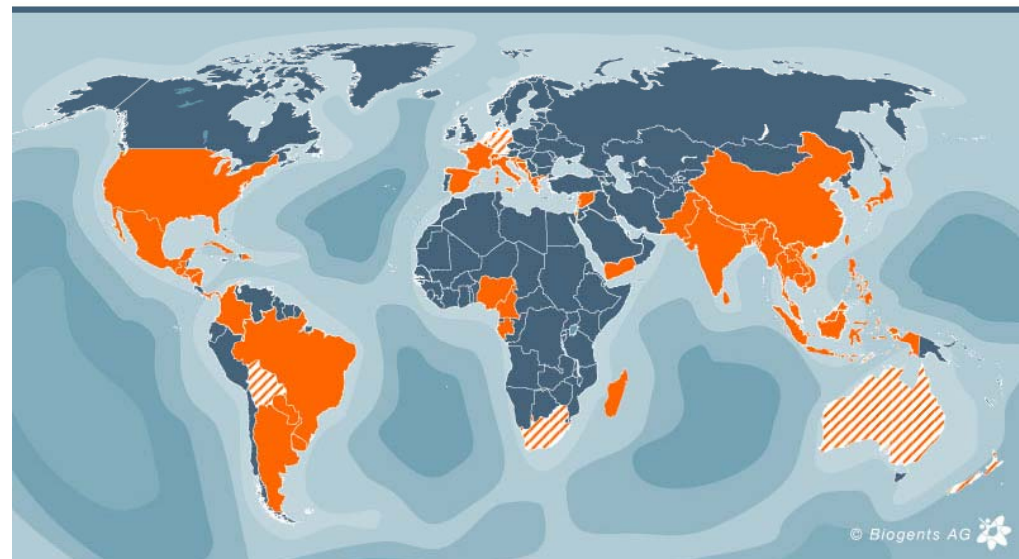
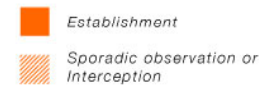
<http://phil.cdc.gov/phil/home.asp>

Dengue Vectors

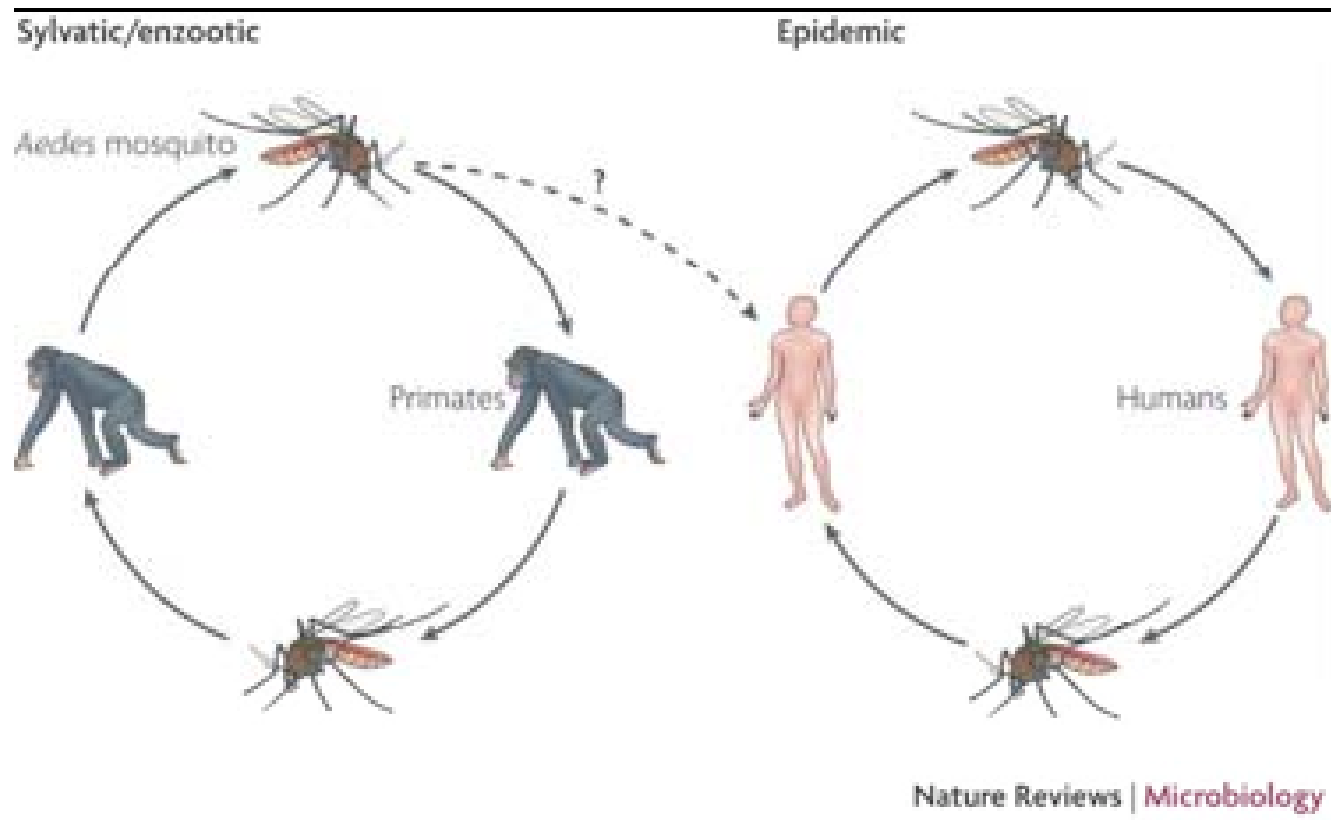
- *Aedes aegypti* is the principle vector
- *A. albopictus* also a competent host
- Diurnal



Global distribution of the Asian tiger mosquito (*Aedes albopictus*), 2008.



Dengue in non-human primates



Whitehead SS, Blaney JE, Durbin AP, and Murphy BR. Prospects for a dengue virus vaccine. *Nature Reviews Microbiology*. 2007; 5: 518-528.

Rudnick A (1965) Studies of the ecology of dengue in Malaysia: a preliminary report. *J Med Entomol* 2: 203-8.

Rudnick A, Marchette NJ, Garcia R (1967) Possible jungle dengue--recent studies and hypotheses. *Jpn J Med Sci Biol* 20: 69-74.

Rodhain F (1991) The role of monkeys in the biology of dengue and yellow fever. *Comp Immunol Microbiol Infect Dis* 14: 9-19.

A world without mosquitoes

- *“The ecological effect of eliminating harmful mosquitoes is that you have more people.”*

Fang, J. (2010). "Ecology: A world without mosquitoes." Nature 466(7305): 432-4.

IMAGE: A City of Winnipeg truck fogs a street with malathion (CBC)



Philippines

- 2010 (Jan-Sep) 98,934 cases with 644 deaths (double 2009)
- DOH concluded 2010 was the year of living “dengue-rously”
- Department of Science and Technology (DOST) developed a DOST Ovicidal and Larvicidal (OL) mosquito trap
- The traps are black (females like to lay their eggs in dark coloured containers) and contain lawanit wood (also attractive to female mosquitoes).
- Trap contains plant derived ovicides and larvicides that kill the eggs on contact.
- Non-toxic to humans and can be used in a set and forget scenario
- Promoted at the first ASEAN Dengue Day (June 15 2011)
- National rollout

oltrap.dost.gov.ph

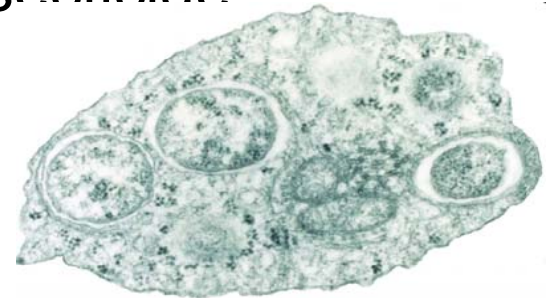


National Mosquito Control Week: Sri Lanka

- 7,948 cases of Dengue to date with 69 deaths
- June 20 – 26
- In the first day 58,600 locations were inspected
- 3,183 places with dengue mosquito larvae were discovered in the first day
- 30,139 property owners were ordered to clean mosquito breeding places
- Legal action was taken against 1,270 property owners who had violated relevant rules and regulations

Wolbachia in *Aedes* populations to suppress dengue transmission

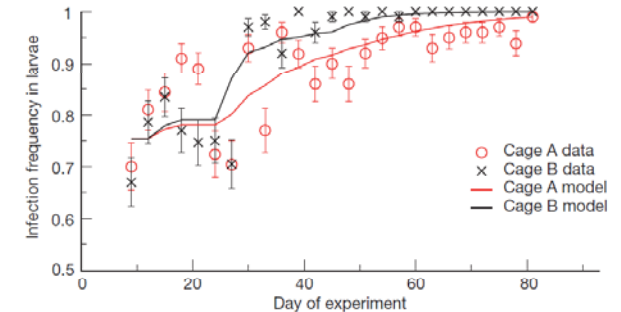
- *Wolbachia*
 - Intracellular arthropod bacteria (reproductive tissues)
 - Manipulates host reproduction
 - Parthenogenesis, feminization etc
 - Often confers phenotypic traits (insecticide resistance)
- *Wolbachia* in *Aedes*
 - Maternally inherited
 - Causes cytoplasmic incompatibility
 - rapid invasion of host populations



wMel *Wolbachia pipientis*



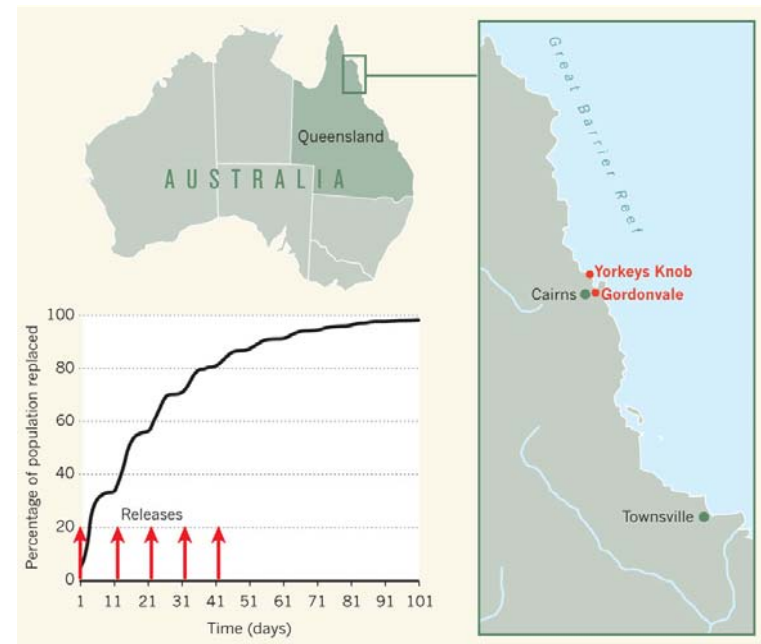
- Naturally occurs in *D. melanogaster*.
- Interferes with RNA viruses.
- Adapted to *A. aegypti*.
- No significant fitness costs.
- 10% reduction in lifespan.
- Complete blockage of DENV-2 transmission under experimental conditions.



- Walker T, Johnson PH, Moreira LA, Iturbe-Ormaetxe I, Frentiu FD, et al. (2011) The wMel Wolbachia strain blocks dengue and invades caged *Aedes aegypti* populations. *Nature* 476: 450-3. doi: 10.1038/nature10355.

Successful establishment of *Wolbachia* in *Aedes* populations

- Open release was approved by the Australian Pesticides and Veterinary Medicines Authority.
- Wild breeding grounds were treated one month before the trial began.
- ~190 release sites at each location
- 9 releases at each location
- ~150,000 mosquitos released at each location (males and females)
- Ovitrap, sentinel traps and natural breeding sites surveyed

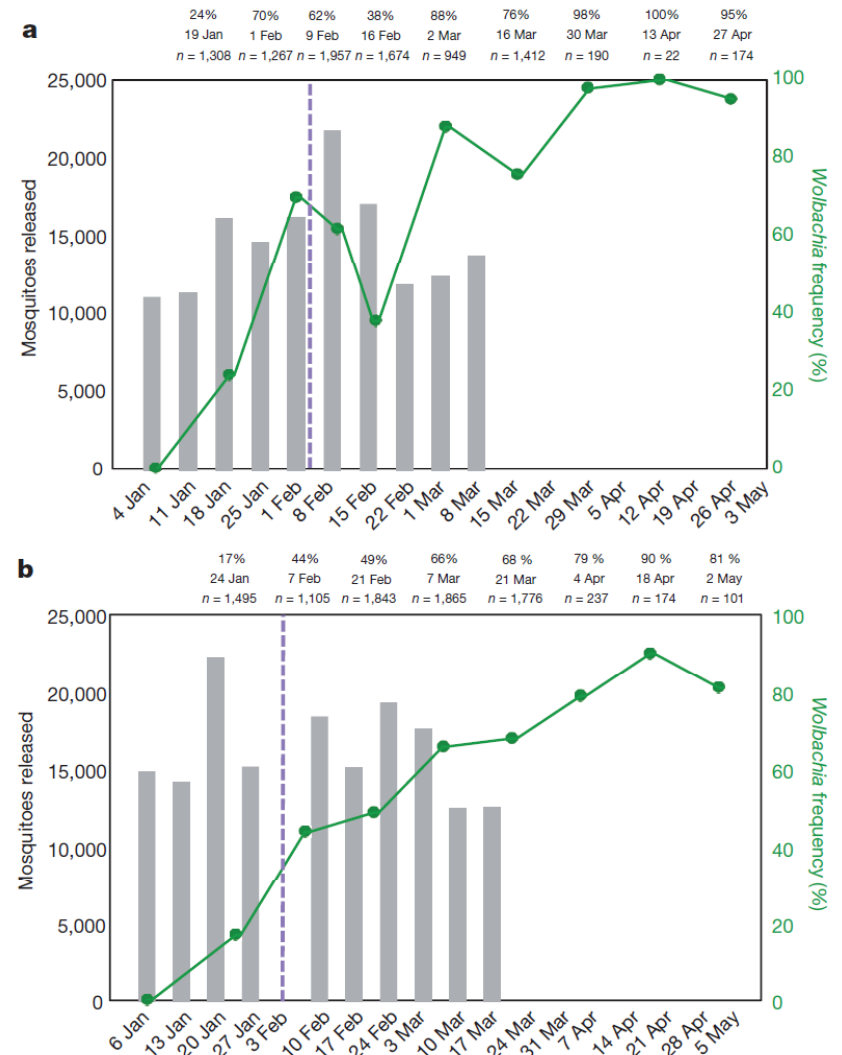


- Successful invasion at both sites.
- Limited dispersal (<1.5km).

Conclusions

- Nursery sites easily established.
- Deployment simple and low cost.

Hoffmann AA, Montgomery BL, Popovici J, Iturbe-Ormaetxe I, Johnson PH, et al. (2011) Successful establishment of *Wolbachia* in *Aedes* populations to suppress dengue transmission. *Nature* 476: 454-7



Conclusions

- Vector control strategies work, but are expensive, time consuming and need to continue indefinitely.
- “Vaccinating the vector” may be an alternative long term solution.

References

Walker T, Johnson PH, Moreira LA, Iturbe-Ormaetxe I, Frentiu FD, et al. (2011) The wMel Wolbachia strain blocks dengue and invades caged *Aedes aegypti* populations. *Nature* 476: 450-3. doi: 10.1038/nature10355.

Hoffmann AA, Montgomery BL, Popovici J, Iturbe-Ormaetxe I, Johnson PH, et al. (2011) Successful establishment of Wolbachia in *Aedes* populations to suppress dengue transmission. *Nature* 476: 454-7

Rasgon JL (2011) Dengue fever: Mosquitoes attacked from within. *Nature* 476: 407-8.

Fang, J. (2010). "Ecology: A world without mosquitoes." *Nature* **466**(7305): 432-4.