

# RUTGERS

School of Environmental  
and Biological Sciences

## Gene Drives: Advances in Insect Control

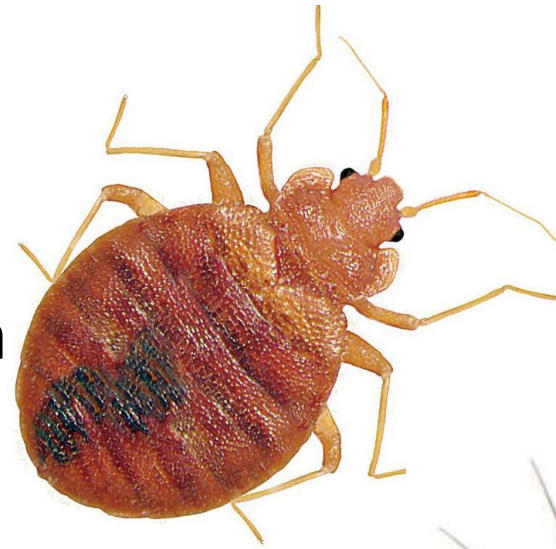
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# Insect Biology

- Insects make an ideal **model organism**

- Well-studied genomes
- Genes of interest targeted



- Pest Impact

- Crop loss worldwide: **\$400 billion** per year
- Termite damage from 1 species: more than **\$1 billion** per year



- Resistance to pesticides (*Scarpino and Althouse, 2019*)

- In the US, emergency visits resulting from bed bugs increased by **over 700%** between 2007 and 2010



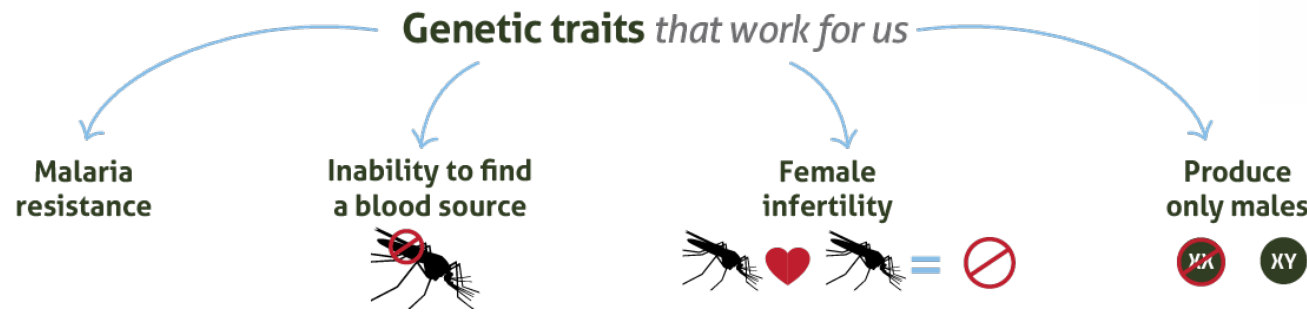
# In Insect Control

- Gene drives have been proposed as a way to:
  - Reduce or eliminate insect-borne diseases
  - Reverse insecticide resistance
  - Reduce the capacity of pests to consume crops (*Sugahara et al. 2015*)
  - Limit disease spread by introducing heritable immunity into reservoir populations (*Tsao et al. 2004*)
- No engineered gene drive has yet been released into the wild

Solitary



Gregarious



# In Insect Control

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- Beneficial Insects

- Honey bees are the most significant pollinator
- Colony Collapse Disorder is reducing the bee population



Solitary



# Ethics and Concerns

- **Conservation:** Potentially powerful enough to cause a species to become extinct (*Webber 2015*)
- Unintentional dispersal of modified organisms into non target ecosystems (*Webber 2015*)
- Transfer of gene drives to **non-target organisms** (*Snow et al.,2005*)
- Likely the most promising tool for controlling devastating diseases, misuse or loss of public confidence may lead to interference in its future applications (*Esvelt K.M, 2017*)

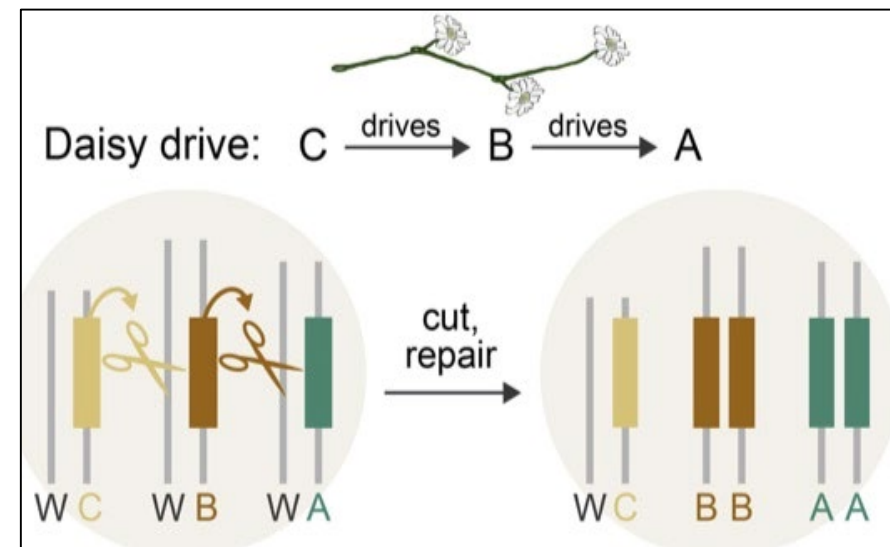


# Future Investigation

- Determining **which genes** are most effective to target requires further studies (*Kyrou et al. 2018*)
- Regulatory issues must be addressed prior to widespread use in the wild (*Oye et al. 2014, Adelman et al., 2017*)
- Self limiting gene drives may be a safer model for release into wild populations (*Webster 2019, Noble et al., 2019*)



photo McEvey 2017



# Conclusions

- **Gene Drives** are a promising technology in use of control of insect pests and vectors
  - The most specific pest control strategy
- **More testing** is needed to determine the safety and efficacy of a large release
- **Misuse** of this technology may lead to loss of public confidence and drastic ecological impacts

