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 \((\text{Sugahara et al. 2015})\)
  • Limit disease spread by introducing heritable immunity into reservoir populations \((\text{Tsao et al. 2004})\)

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

- Honey bee image
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)*
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