Assessing Fitness of *Culex pipiens* Mosquitoes Selected for Enhanced Survival to Methoprene

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Introduction

- West Nile virus (WNV) is the most widespread arthropod-borne viral disease in the United States and is transmitted primarily by *Culex pipiens*.
- Methoprene is a pesticide used to control mosquito populations.
- Evolution of resistance threatens the longevity of any given insecticide with continued use.
- The objective of this research is to examine any fitness costs associated with resistance to methoprene in *Cx. pipiens.*
- Fitness will be examined by measuring wing length in laboratory-reared methoprene resistant and susceptible colonies of *Cx. pipiens.* Wing length serves as a proxy for body size.
- It is hypothesized that methoprene resistance in *Cx. pipiens* mosquito populations will result in fitness costs, such as reduced wing size.

Methods

- The Bernhardt Lab artificially selected a *Cx. pipiens* colony from a susceptible strain for enhanced methoprene survival (we will call this colony “resistant” for simplicity); these two colonies were used to collect wing measurements.
- A sample of larvae were taken from both the susceptible and resistant colonies and reared to adulthood. Larvae were either exposed to insecticide or not.
- The adults that survived were frozen at -80°C to kill them. The adults were then thawed and the right wings were removed with forceps and iris scissors.
- The wings were placed on a slide under a Leica IC30 stereo dissecting microscope and wing length was measured to the nearest micrometer using software.
- Measurements for length were taken from the axillary incision to the apical margin.
- A Generalized Linear Model (GLM in R) was used to analyze the data with males and females analyzed separately.
- Wing measurements were taken for Resistant No Pesticide (RNP), Resistant Pesticide (RP), Susceptible No Pesticide (SNP), Susceptible Pesticide (SP) for both males and females separately. 40 wing measurements were made in each category for a total of 320 wing measurements.

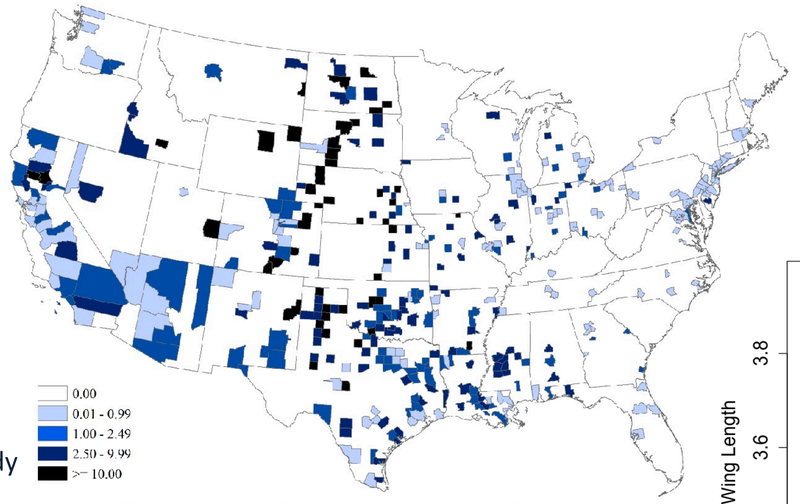


Figure 1: West Nile Virus neuroinvasive disease incidence, by county, 2015

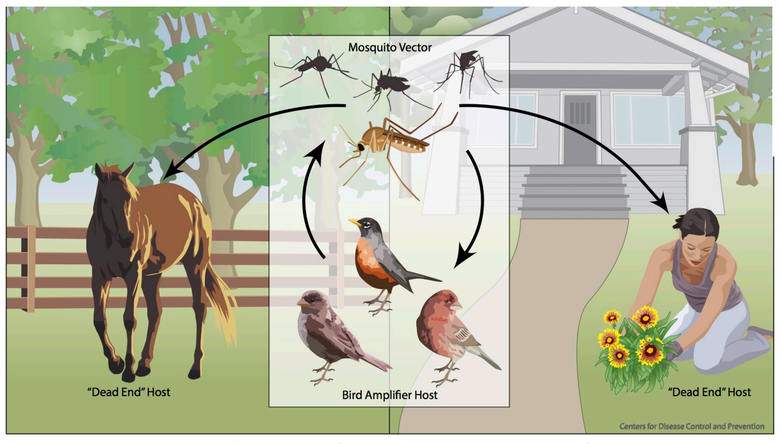


Figure 2: **West Nile Virus Transmission Cycle**

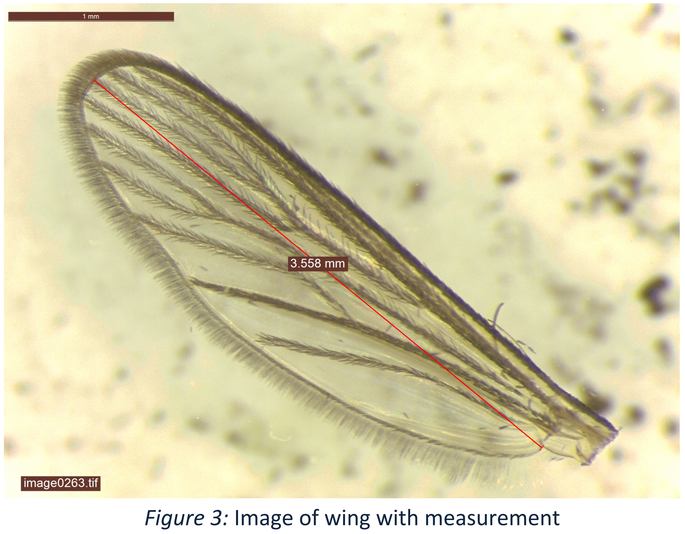
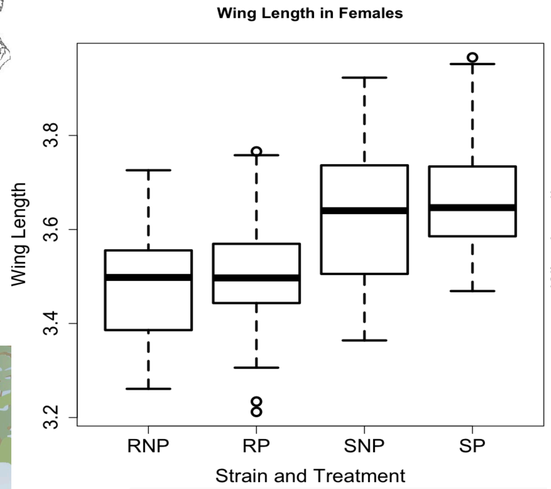
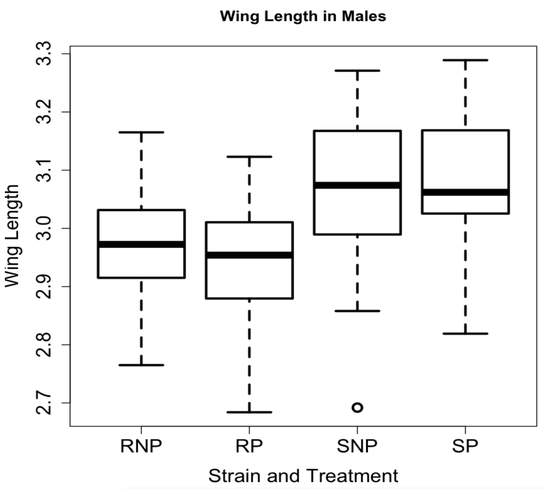


Figure 3: Image of wing with measurement

Results

- **There was a significant difference in wing length between the susceptible colony and resistant colony in both males (p<0.001) and females (p<0.001). There wasn't, however, a significant difference in wing length within a colony based on pesticide treatment.**





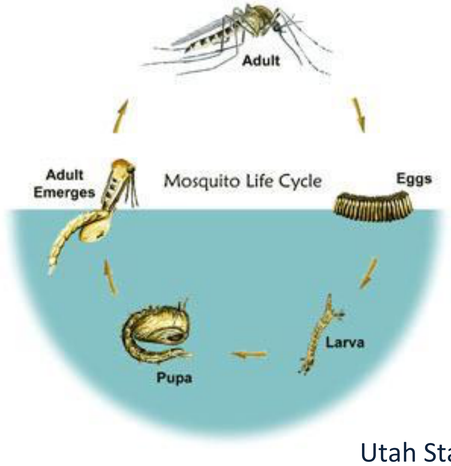
Fixed Effects	t-value	p-value
Strain (colony)	4.855	2.97×10^{-6}
Pesticide	0.481	0.677
Strain (colony)×Pesticide	0.682	0.496

Table 1: Generalized linear model analysis for wing length in Females

Fixed Effects	t-value	p-value
Strain (colony)	4.019	9.06×10^{-5}
Pesticide	-1.373	0.172
Strain (colony)×Pesticide	1.435	0.153

Table 2: Generalized linear model analysis for wing length in Males

Figure 4: Mosquito life cycle



Conclusion

- The artificially selected colony (resistant) had a statistically significant reduction in wing length compared to its susceptible counterpart in both males and females. This indicates a reduction in body size. More information needs to be collected to determine if this translates to a fitness cost or not.
- The knowledge of fitness costs are essential for predicting the persistence of the resistant phenotype in the absence of pesticide treatment.

Acknowledgments

Utah State University URCO – Funding
Blaine Oakeson from Central Life Sciences – Provided Pesticide