Utilizing Microbiome Transplants to Improve Landscape-Scale Mosquito Suppression

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In Hawai‘i, the mosquito Culex quinquefasciatus carries avian malaria, threatening extinction for Native Hawaiian forest bird species. The most effective and environmentally friendly method of controlling mosquito populations is the Wolbachia IIT. In this method, male mosquitoes are mass reared in labs and infected with an incompatible strain of the bacteria Wolbachia (rendering them infertile when mating with wild mosquitoes) and released to mate with wild females. Eggs resulting from this cross are unviable causing the wild population to decrease over time. However, fitness of lab-reared mosquitoes is compromised, potentially due to being unable to gather a robust microbiome. This naturally poses the question: Can the Wolbachia IIT method be improved by a microbiome transplant to improve lab-raised mosquitoes fitness? In this study, microbiomes were transplanted from wild sources into lab-raised mosquitoes and changes in developmental rate and physical fitness were measured. Then, genomic sequencing was used to analyze transplanted microbiomes. The field water method was determined to improve lab-raised mosquito developmental rate by 18% and physical fitness by 67% by introducing various bacteria that play different roles. This improved method of Wolbachia IIT has significantly improved efficacy allowing for more Wolbachia-infected mosquitoes (improved developmental rate) with increased fitness to be released into the wild. The results of this study allow for improved success in the global use of Wolbachia in landscape-scale mosquito suppression efforts. Not only does this research have applications for statewide conservation efforts, but results from this project can be used to control other insects carrying vector-borne diseases like malaria and agricultural pests.