Question

How does selection (insecticide spraying) affect the movement of resistant alleles in mosquito populations?

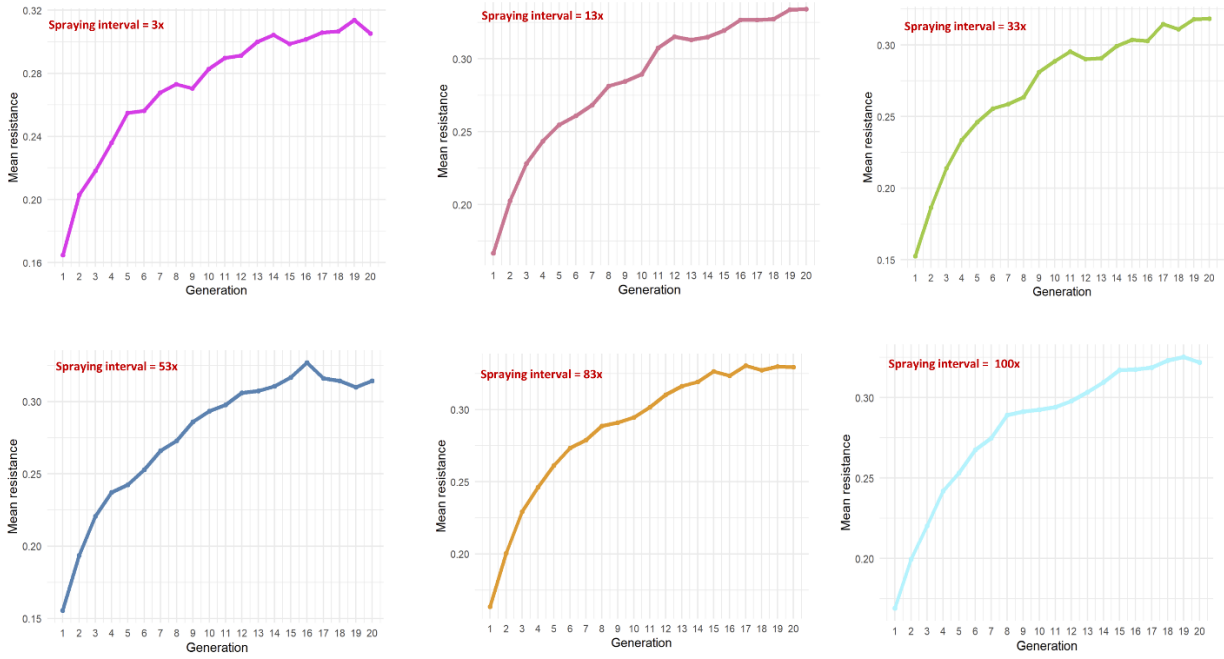

Figure 1: Mean resistance over time. The parameters for this model were set to vary the spraying frequency but keep the percentage of mosquitoes sprayed constant at 50%, the starting mean resistance at 0.1, and the mortality rate at 0.7. The rest of the parameters that were kept constant can be found in the code. Insecticide resistance seems to be affected by the frequency of spraying events. The more insecticides are sprayed, the more resistant the population becomes.

Discussion

The most crucial element of the global plan for managing diseases linked to mosquitoes is vector control, of which insecticide treatment is a crucial component. Unfortunately, insecticide-resistant mosquito and drug-resistant infections have led to the recent resurgence of mosquito-borne diseases, indicating a challenge/failure in our approach. Apart from its significance for global insect vector management, insecticide resistance is seen as an important evolutionary phenomenon (Naqqash et al., 2016). Insecticide resistance is a complicated process that is influenced by several factors, including genetic, physiological, behavioral, and ecological ones; it is also indirectly influenced by the amount and frequency of insecticide applications (Zhu et al., 2016). To stall the emergence of resistance, several control programs were operationally shifted from blanket spraying to focused use (Hemingway and

Ranson, 2000). However, mosquitoes have all the necessary traits for a quick selection of resistance, including short life cycles with lots of offspring and other innate traits. The phenomena of pesticide resistance have been linked to an adaptive process, which accounts for the presence of uncommon individuals possessing one or more resistant alleles that enable them to proliferate when insecticides are applied (Liu, 2015).

Using this logic, we can see that when the starting mean resistance in our model is set to 0.1, and only 50% of the mosquitoes are sprayed, we might see an increase in mean resistance over multiple generations. However, it would be interesting to see how a reduction or increase in the size of the target population for spraying would affect the build-up of resistance over time while keeping the same spraying frequency. This will be addressed in the model as we continue to build it. We will also be addressing how these resistant genes move between landscapes and species.

References

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