Analyzing the Presence of the KDR Mutations and Distribution of Siphonapterans in Waco, Texas

Overall, the objective of developing this code was to create a visualization that represents the distribution of the rat flea *Xenopsylla cheopis,* a significant vector that is competent for infection and transmission of *Yersinia pestis* in Waco, Texas. The visualizations were to highlight the results based on two primary questions:

1. Are mutations in the KDR locus more prevalent in fleas living in urban areas as a result of higher insecticide exposure in these regions, versus rural areas?
2. Is passive transport a mechanism behind higher insecticide resistance in fleas?

In the hypothetical dataset provided (fleas.csv), data was listed that included the following information: individual ID of the collected flea, location in latitude and longitude coordinates, site designation (urban, urban-highway, rural, rural-highway), the presence of a mutation at the KDR locus, and the host the flea was found upon. Twenty individuals were ‘sampled’ from each of the four sites. Sites designated as ‘urban’ were located in regions with high human population density and were more than 1km away from a major interstate highway (I-35), while ‘urban-highway’ sites were located in regions with high human population density and were less than 1km away from I-35. ‘Rural sites’ were located in regions with a low human population density and were more than 1km away from I-35, while ‘rural-highway’ sites were located in regions with a low human population density and were less than 1km away from I-35.

The hypothetical dataset suggested that there was no association with proximity to the highway and higher instances of KDR mutations in fleas. However, it was suggested that there was association with the human population density and high instances of KDR mutations in fleas. This was visualized on an interactive map interface that differentiated between KDR-mutant and -nonmutant fleas, as well as listing individual ID and host-association for each flea. While host-associated is more tightly-knit in fleas, it is possible for rat fleas to incidentally feed on other hosts, so this information is important to collect as well. Other data that will need to be collected in a real study is sex, blood-feeding status, infection status (with *Y. pestis* or other pathogens), and date collected.

This surveillance study will be the first of its kind in Waco, Texas, and one of the first comprehensive studies of flea population dynamics in Texas in several decades.

**References:**

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