



Rational

Mosquitoes, deemed the deadliest creatures on Earth due to the diseases they transmit, have caused more fatalities than all recorded wars combined. Investigating the macroecology of mosquitoes on a continental scale is imperative for effective disease management and prevention. Our study utilized observational data from 17 sites within the National Ecological Observation Network across the United States. Extracting information from three NEON databases—mosquito samples, mosquito pathogen status, and weather statistics—we analyzed 45,000 labeled data points to elucidate the spatial distribution of mosquito abundance and its environmental determinants.

Methodology – Site information

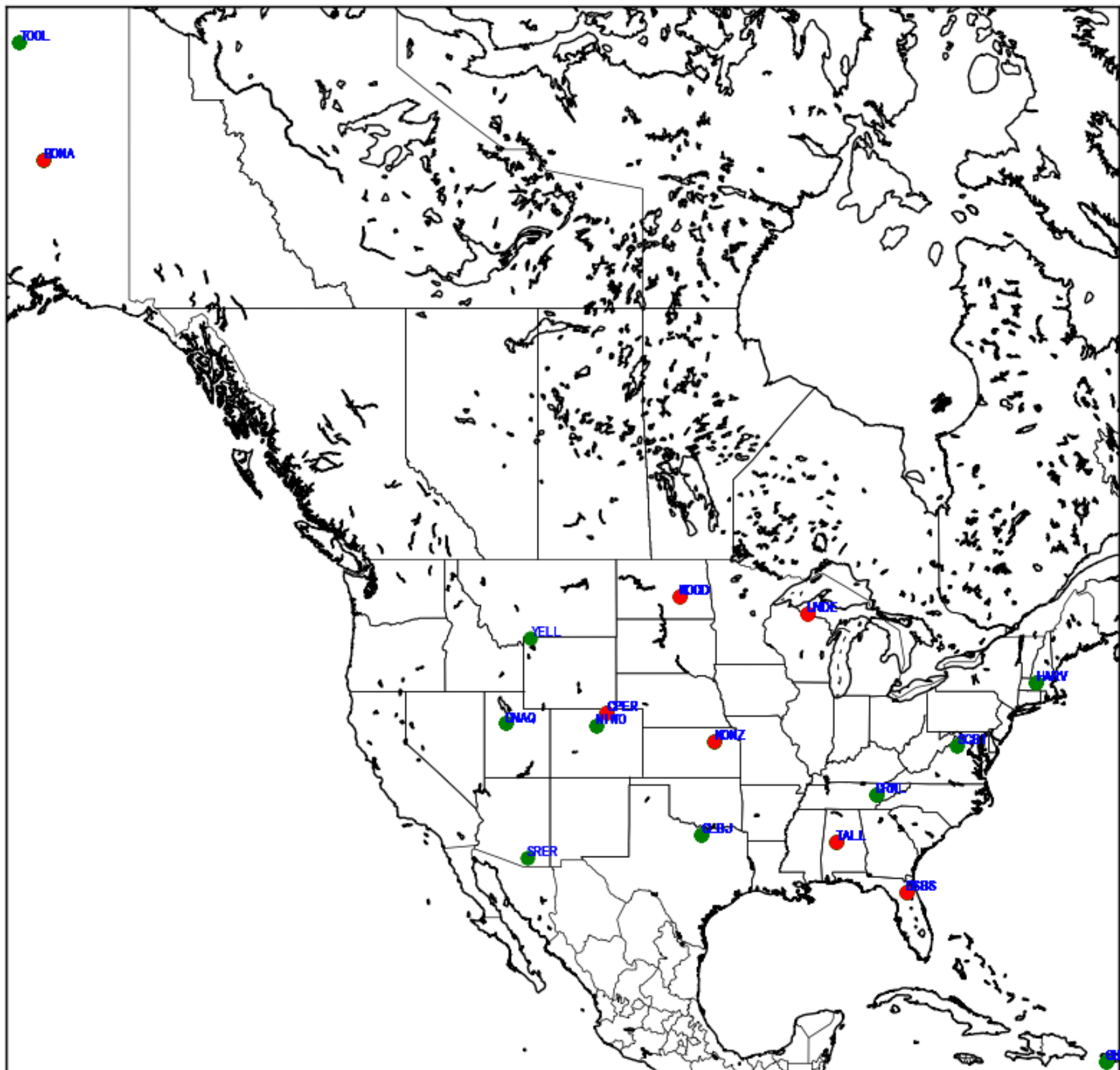


Figure 1. Location of sampling sites from the NEON Domain. See Table 1 for the detailed information; 17 sites were used in this study;

HARV, TALL, CLBJ, SRER, ORNL, GUAN, NIWO, ONAQ, OSBS, SCBI, YELL, UNDE, KONZ, CPER, WOOD, BONA, TOOL

location	Latitude	Longitude
HARV	42.53691	-72.17265
TALL	32.950461	-87.393269
CLBJ	33.401231	-97.570033
SRER	31.910711	-110.83547
ORNL	35.964135	-84.282592
GUAN	17.969511	-66.868664
NIWO	40.054269	-105.58238
ONAQ	40.177599	-112.452429
OSBS	29.689289	-81.993431
SCBI	38.892925	-78.139494
YELL	44.953477	-110.539165
UNDE	46.23391	-89.537254
KONZ	39.100781	-96.563083
CPER	40.815538	-104.74559
WOOD	47.128223	-99.241321
BONA	65.154044	-147.502561
TOOL	68.66109	-149.37047

Table 1. Description of sampling sites taken from the NEON Domain

Environmental impacts on mosquito populations & infection rate

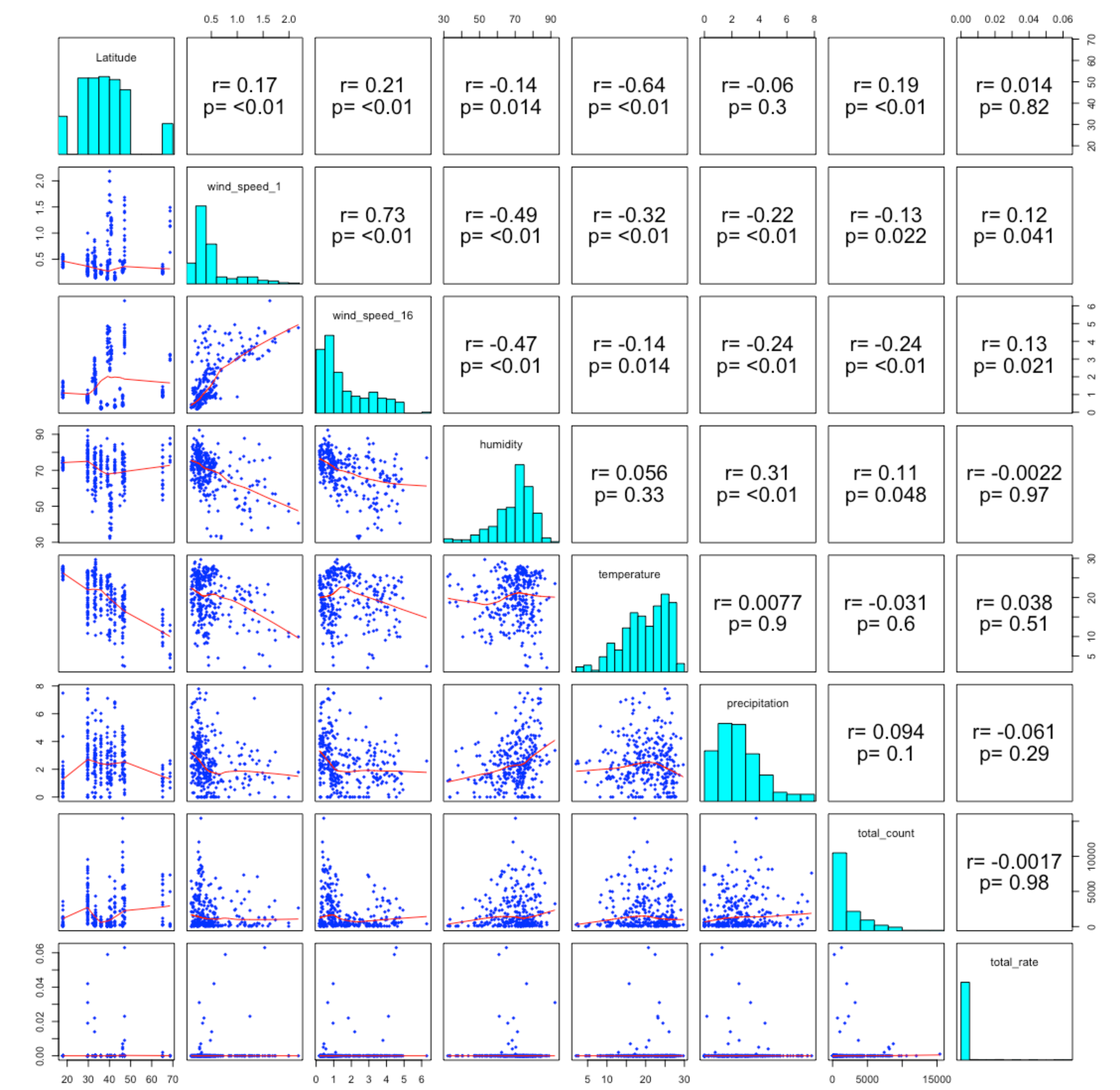


Figure 3. Correlation matrix of mosquito population density and infection rate across all sites and months; wind_speed_1; wind speed at 1 meter height; wind_speed_5: wind speed at 5 meters height; wind_speed_16: wind speed at 16m height; as air pressure is not shown as no significant correlation is observed.

- High humidity can result in slower water evaporation from water bodies such as ponds. Thereby, a mosquito can easily have a habitat for populations to breed
- There is a preferred humidity (~70%) at which the mosquito population peaks.
- Strong winds can disturb mosquitoes in flight, thus affecting their food-finding and breeding activities.

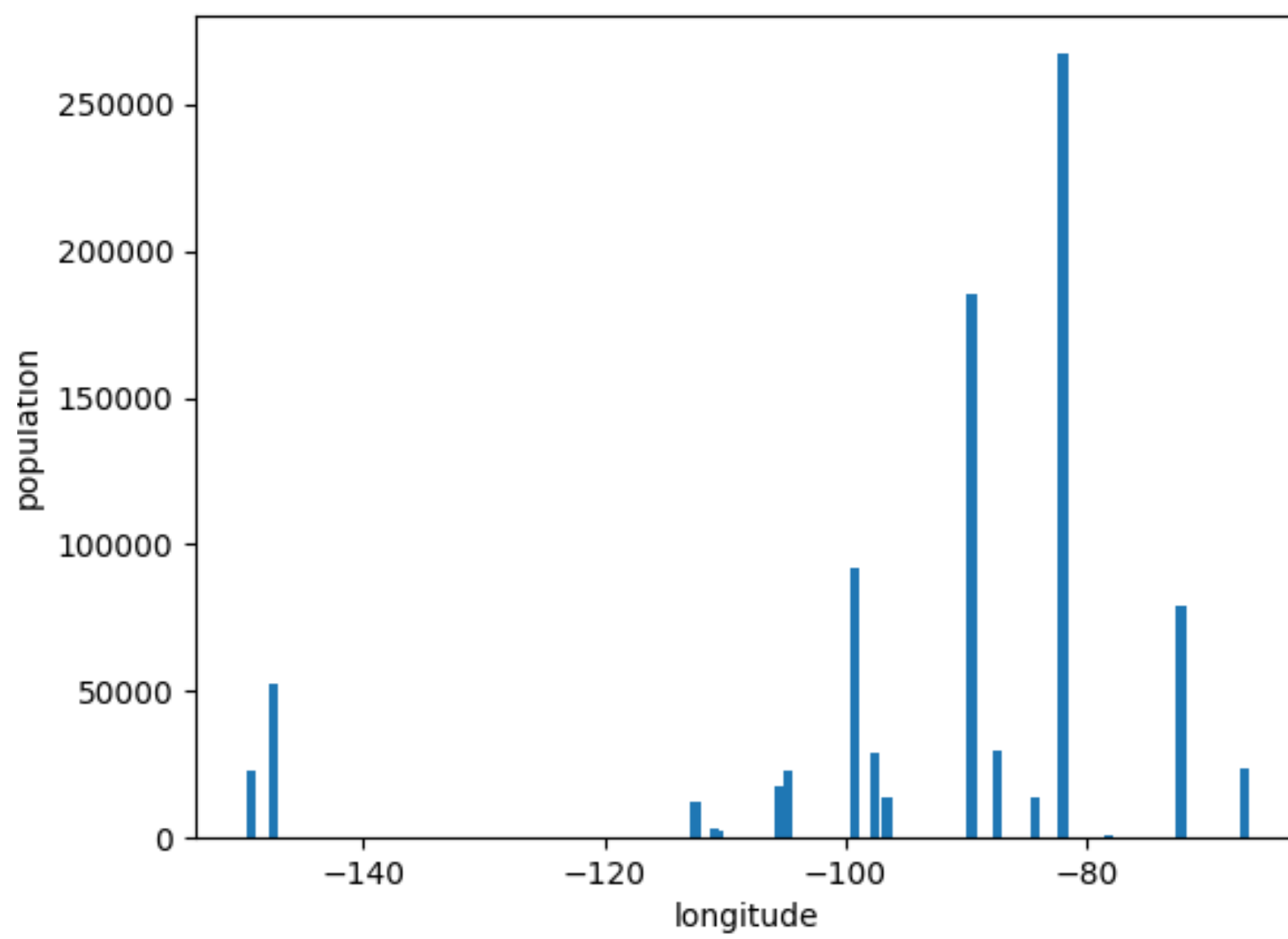
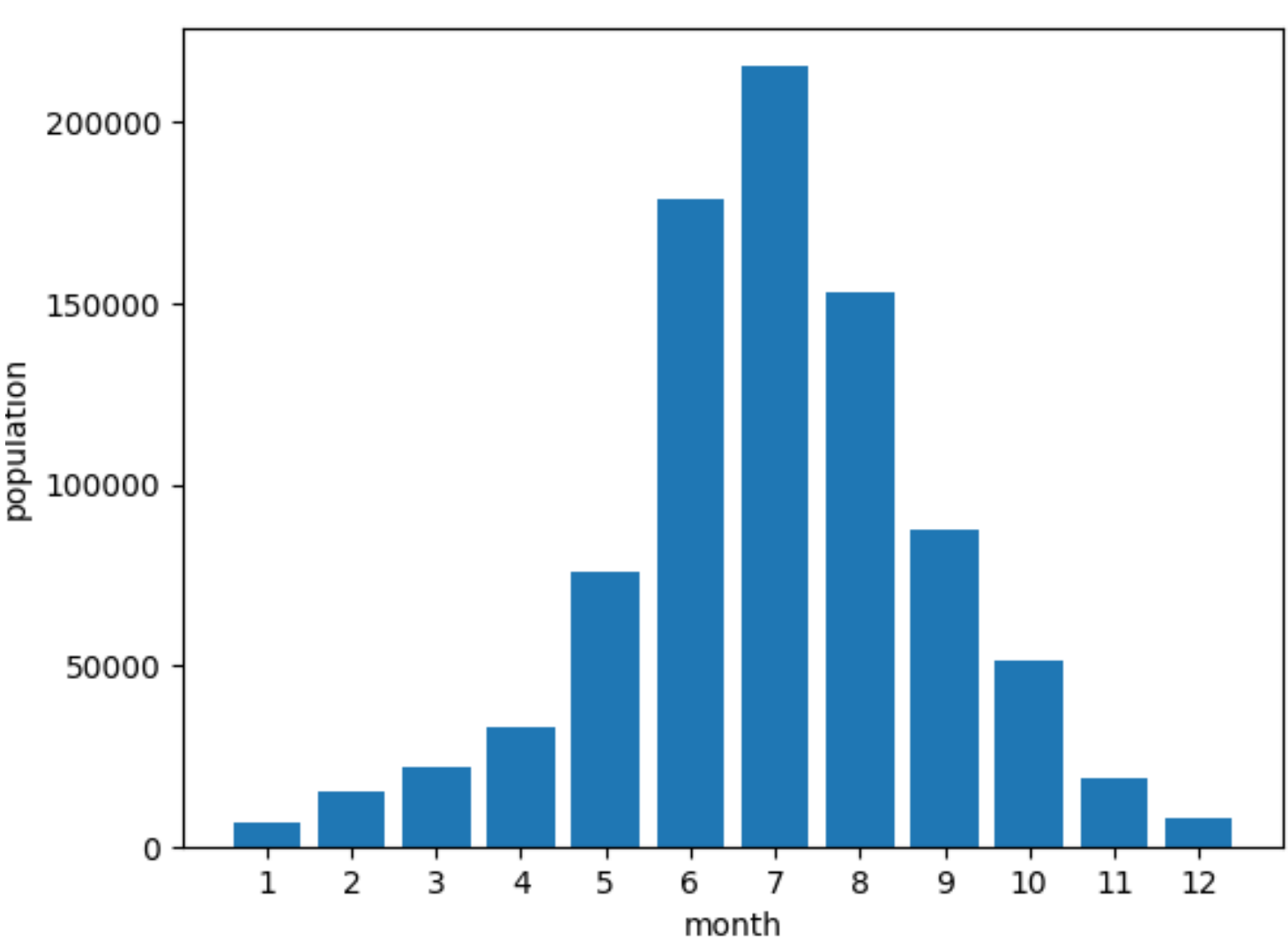


Figure 4. Seasonal variation of mosquito population, similar for infection rate (pathogen)

- Similar observations apply to mosquito populations and infection rates.
- Population reaches a peak around July while Pathogen rate reaches a peak in August: propagation takes ~1 month.
- Mosquito population varies over latitude and longitude.

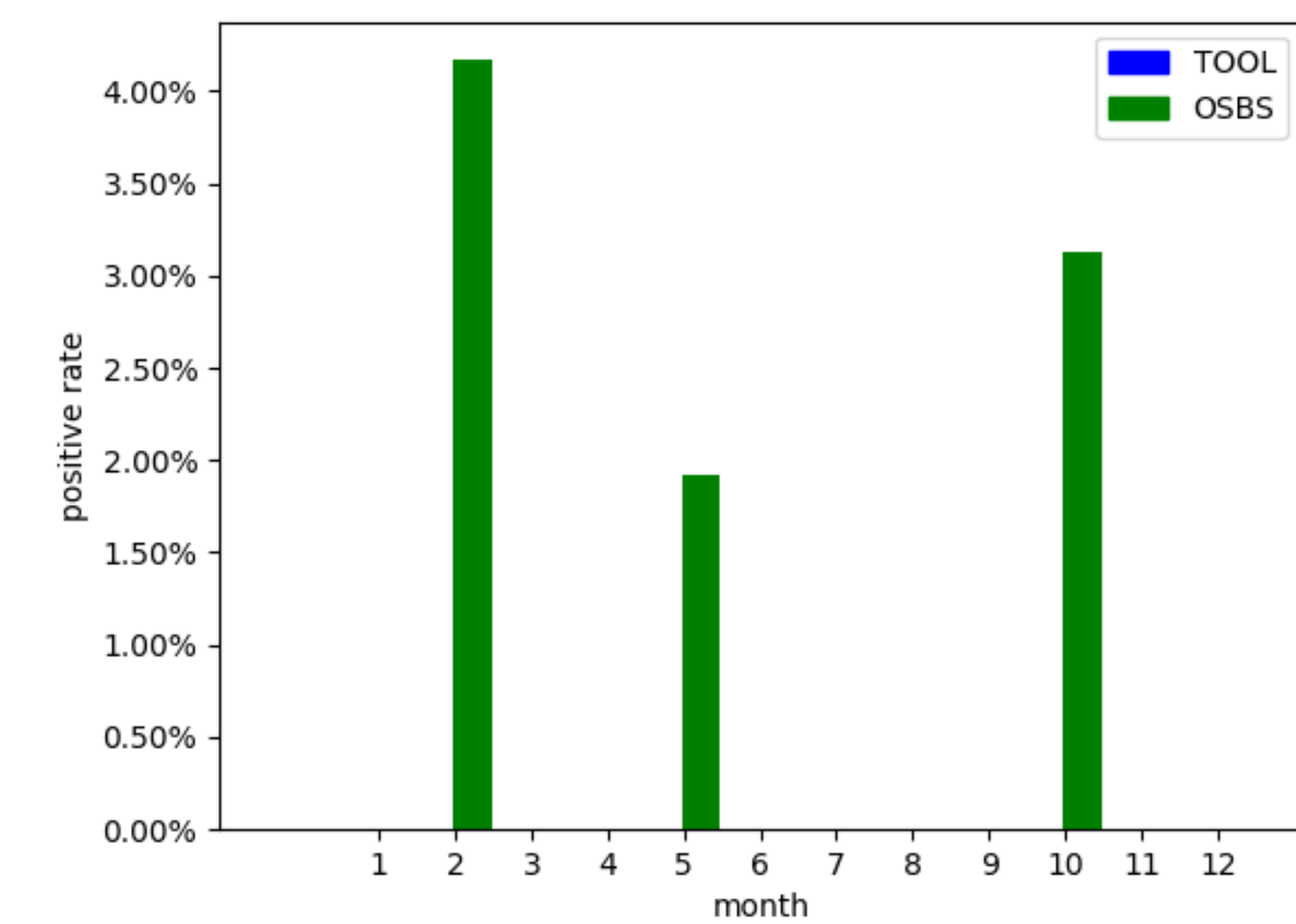
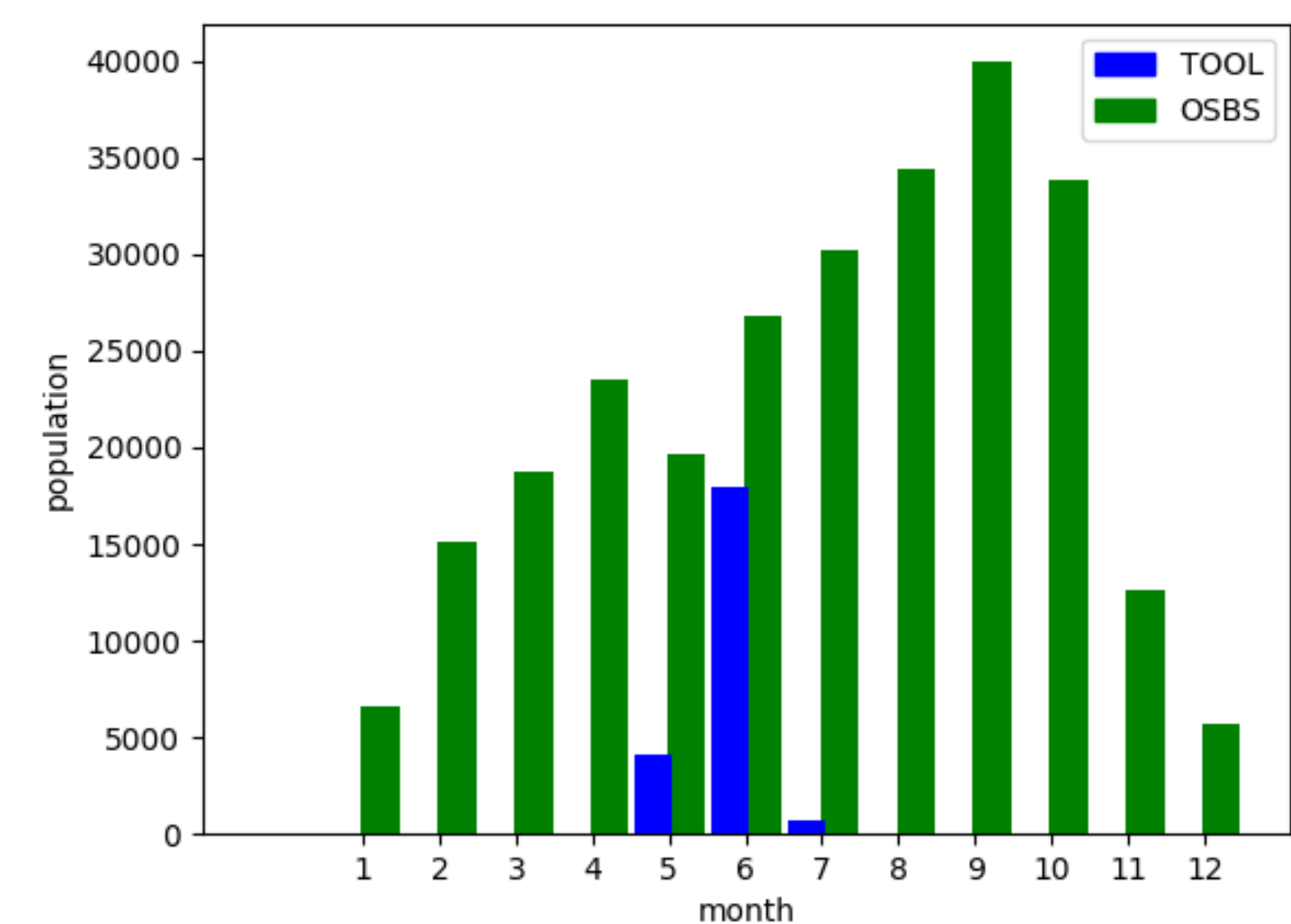
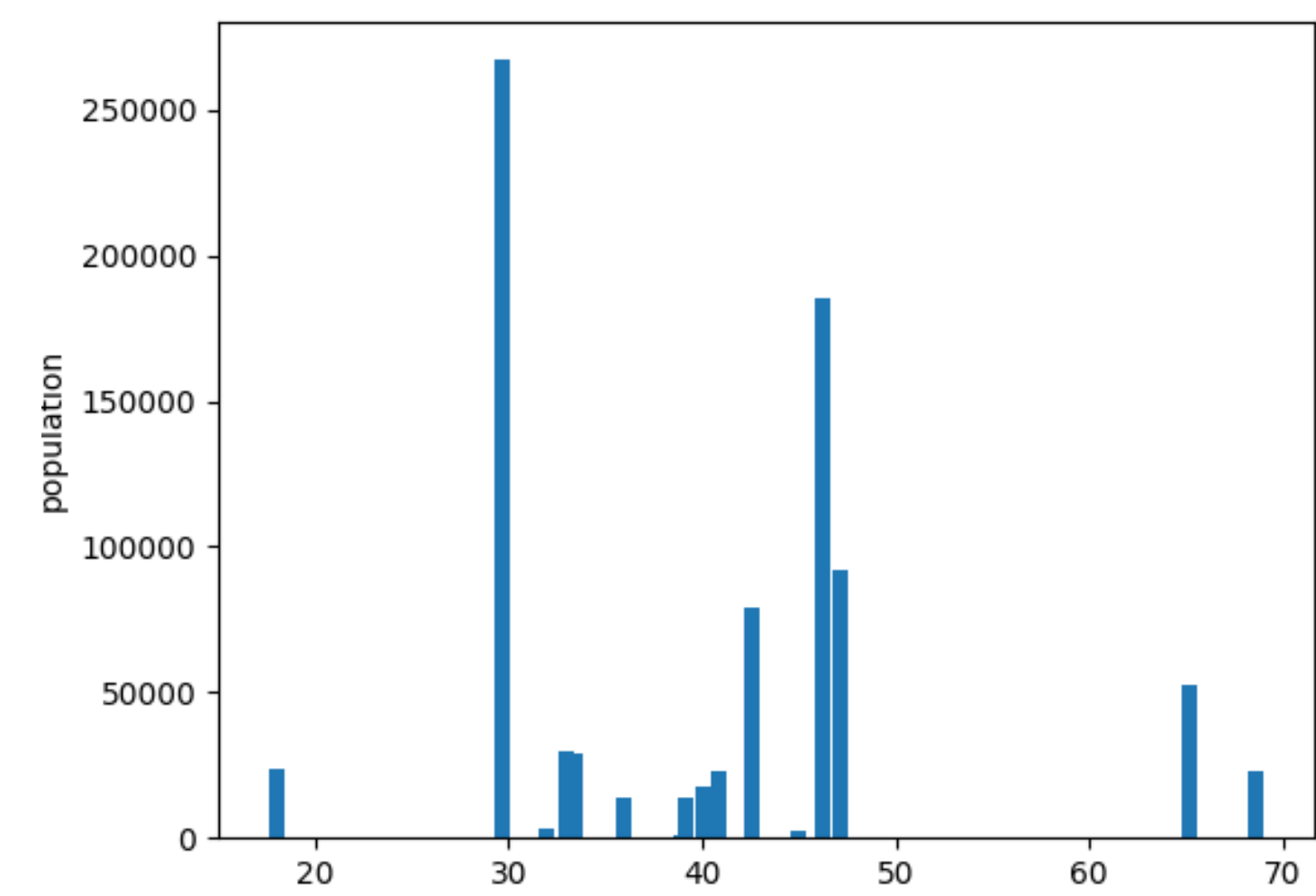


Figure 5. Comparison of mosquito population and infection rate between Alaska and Florida (two sites with extreme climate conditions)

- Much higher mosquito population in Florida than in Alaska, consistent with the latitudinal pattern observed in Figure 2
- The infection rate is higher in Florida and with a stronger fluctuation over months;

Take home message

- Mosquito populations are closely linked to climatic factors, such as humidity and wind speed; no correlation was found between mosquito populations and air pressure.
- Different wind speeds affect the infection rate of pathogens in mosquitoes, which in turn affects the rate of pathogen positivity.
- The clear seasonality of the mosquito population and the positivity of mosquito pathogens indicate that temperature controls the population at a seasonal scale.

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Methodology - Data processing

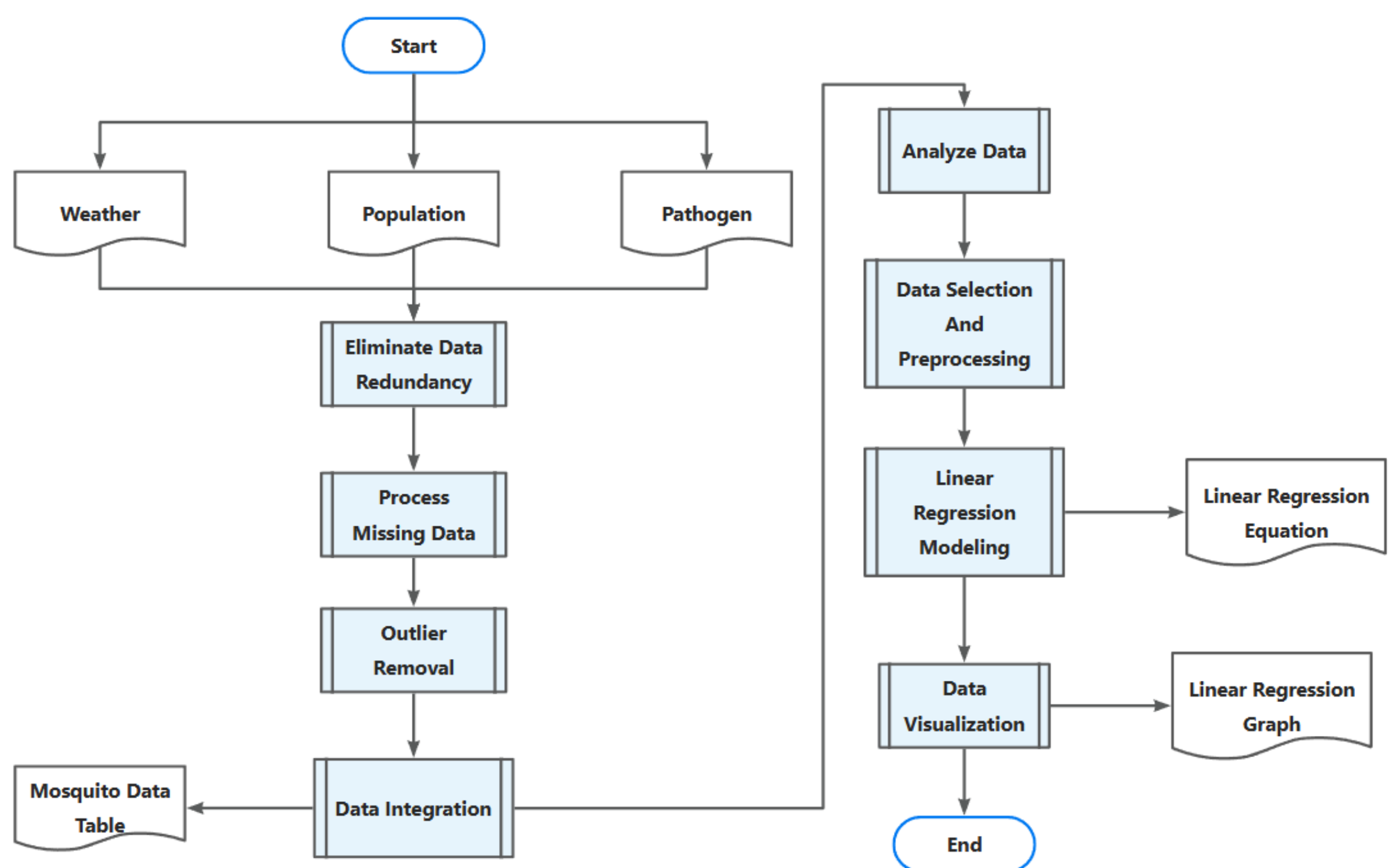


Figure 2. Workflow for data processing in this study

- For missing or unavailable data, assign an average value
- Data Integration: Based on physical location and sample time, integrate the three databases into one
- Location-sample time (weather, population, mosquito pathogen)
- Analyze data: Analyze mosquito population and pathogen relations with weather data.
- Data selection: select representative data from different locations and sample time