Project Proposal

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April 3rd, 2020

Keywords: vector abundance, time series analysis, interpolation, model selection, vector borne disease, mosquitoes

1 Introduction

At the end of the 20th century, the world experienced a global resurgence of infectious disease (Gubler, 2001). Of the many diseases threatening human health, mosquito borne diseases such as malaria, yellow fever, dengue, and Rift Valley fever take millions of lives every year (Yang et al., 2009). Mosquito abundances are affected by many factors, including land-use, elevation, and vegetation cover, but meteorological variables such as temperature and precipitation in particular can be predictors of population dynamics (Yoo et al., 2016). Rainfall produces basins of water for breeding while temperature mediates life-history processes at all life stages (Yang et al., 2009; Beck-Johnson et al., 2013). Intervention in the growth of mosquito popualtions through chemical control measures is an effective public health strategy for reducing incidence of mosquito borne disease (Tomerini et al., 2011). Timing these intervention measures to interupt peak mosquito abundances can inform cost-effective disease management solutions (Yang et al., 2009).

This investigation will 1.) Use time series analysis to assess which temporal lags of temperature and precipitation are most influential in affecting mosquito population dynamics. This will help illuminate the timing of drivers of abundance dynamics and shape models that are most predictive of abundance. Then, I will 2.) Determine which temporal scale of meteorological and count data (weekly, biweekly, or monthly) is most predictive of mosquito dynamics. This will help assess which time scale of surveillance is necessary for optimal prediction of abundances and also elucidate which time scale of prediction is most appropriate. Finally, I will 3.) Test whether the best-fit models of abundance dynamics developed through questions 1.) and 2.) are able to reliably predict abundances. This is an important step in determining whether the developed model is a useful inclusion in predictions of mosquito abundances for chemical control planning.

2 Proposed Methods

2.1 Temporal Lags

Trap count data will be obtained from the VectDyn database and aggregated to each location by week. Temperature and precipitation data will be obtained from the National Oceanic and Atmospheric Administration Climate Prediction Center and mapped to each trap count location. I will then conduct model fit and selection of lagged and non-lagged models of mosquito abundance as a functions of temperature and precipitation. A final model will be produced combining the best-fit time lags of both temperature and precipitation.

2.2 Interpolation

I will then aggregate count and meteorological data to weekly, biweekly, and monthly scales. In instances where data is not fine-scaled enough to do so, data points will be interpolated through mean-filling. Model fitting and selection will then be conducted to find the best-fit temporal lag of both precipitation and temperature at each temporal scale. This can be repeated with other, lower quality, datasets where interpolation is more frequently necessitated in order to assess the effect of interpolation on model selection.

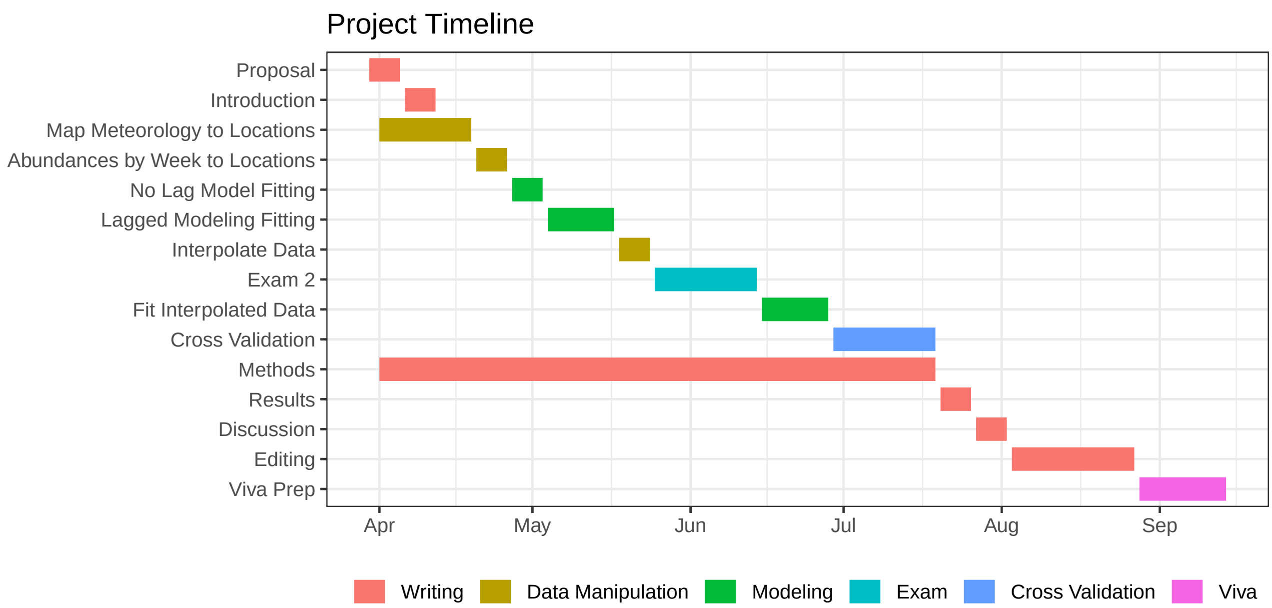
2.3 Cross-Validation

I plan to do a leave-one-out cross validation procedure where I train the best-fit model on a collection of time series in each location as well as each temporal scale. I would then test the resultant models on a sample time series from a year that was not used to train the models. I can then assess the performance of the prediction models against the observed data.

3 Anticipated Outputs and Outcomes

From my investigation, I aim to characterize the best-fit temporal lag between temperature and precipitation and mosquito population dynamics. Using interpolation at different time scales, I will be able to gain an understanding of appropriate temporal scales at which to estimate vector dynamics. I will also be able to assess the quality of abundance predictions made by different temporal scales and different extents of interpolation through cross-validation.

4 Project Feasibility and Timeline



5 Budget

Category	Item	Cost
Lab Equipment	External monitor to extend my work area beyond my 13" laptop screen	£120
	External keyboard	£25
	Rechargeable batteries and charger for powering keyboard sustainably	£15

I have seen and approved the project and budget

Primary Supervisor Signature

Date

References

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