The Effects of Socioecenomics on the Spread of West Nile Virus in California Counties

West Nile Ninjas

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The material contained in this poster is based upon work supported by the National Aeronautics and Space Administration (NASA) cooperative agreements NNX16AE28A to the Institute for Global Environmental Strategies (IGES) for the NASA Earth Science Education Collaborative (NESEC) and NNX16AB89A to the University of Texas Austin for the STEM Enhancement in Earth Science (SEES). Any opinions, findings, conclusions, or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of NASA.

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ABSTRACT

A study that determines the strength of the relationship between West Nile cases, different races and ethnicities in varying socio-regions in California counties across the time period 2020. Census, the CDC, WorldCover Map, and statistical maps will be used to hypothesized to be most prevalent among minority groups in lower income regions due to increased rates of artificial breeding to lower access to treatment.Our study found that the factors of land cover and income do not play a role in influencing the prevalence of West Nile Virus in a given region. We did however find a positive, linear relationship between white population percentage and the amount of virus cases. Thus, resources for the treatment of West Nile Virus should be allocated where there is a high or rising percentage of white people in the population. In the future, the relationship between land cover and the virus should be reexamined as land cover data is ever improving and more socioeconomic factors should be considered in further studies.

RESEARCH QUESTION

- How do the socioeconomic factors race and income affect the spread of West Nile Virus per California county?

-How does land cover in these socioeconomic regions differ and impact the spread of West Nile Virus?

INTRO

-West Nile Virus was discovered in Uganda in 1937, and spread to the United States in 1999 and from 1999 to 2015 there have been 44,000 confirmed and probable cases of West Nile Virus in the United States

-Differences in saliva of a mosquito have proved to alter the transmissibility of West Nile Virus which allows for more virus transmission, increasing the effectiveness of infection for certain species of mosquitoes

-This study focuses our research solely on counties in California, where various levels of socioeconomic status are displayed that show large disparities in access to resources and medical care, reflected in “diseases of poverty” such as tuberculosis and malaria.

-This study aims to show the link between lower socioeconomic backgrounds and the amount of West Nile Virus cases so that action can be taken against the virus' prevalence in these regions.

RESEARCH METHOD

-Gathered 2020 Census data for all 58 counties in California

-median household income in each county, majority race, and population.

-Our analysis of median income and West Nile Virus cases note that we will only use the 5 highest categories of median income using One-Way Analysis of Variance (ANOVA).

-We define our null hypothesis to be no difference in average percentage of West Nile Virus between income groups in California, whereas our alternative hypothesis is that there is a significant difference in average percentage of West Nile Virus between income groups in California.

-For our first model utility test, we include all counties in California (other than the five with no data), and define β to be the true average change in percent of West Nile Virus cases for every 1% increase in percent of white population in a county(Figure 1)

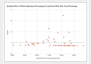

Figure 1: Residual plot of white population percentage & confirmed West Nile Virus percentage for all counties

-Note, in 2020 28 California counties failed to acquire confirmed cases of West Nile Virus so our data was skewed, requiring a second model utility test utilizing only the California counties that had confirmed West Nile Virus cases in 2020

-Calculations were once again performed on the 23 California counties that have confirmed cases of West Nile Virus in 2020 and released white population percentages in 2019 (Figure 3).

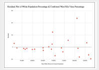

Figure 3: Residual plot of white population percentage & confirmed West Nile Virus percentage for counties with one or more confirmed West Nile Virus cases

-They were placed within the 2013 GeoTests Color Proportions Program developed by L. Jèqou of the University of Toulouse-Mirail to approximate the land cover makeup of a region.

The program observes a map and takes many samples of the image, noting the color, and the number of samples with the specific color which collected a suitable number of samples and organized color data from the county samples to approximate land cover.

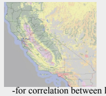

Figure 13: Summary of land cover data for our 5 counties

-for correlation between land cover and West Nile cases within a county we quantify the land cover in the area of five counties: Stanislaus, San Bernardino, Orange, Lassen, and Imperial were randomly sampled.

County	1,000,000 * Confirmed West Nile Virus Percentage (2020)	Built Up	Tree	Grassland	Bare/Sparse Vegetation	Permanent Water Bodies
Imperial	5.56%	0.11%	0%	0%	72.73%	7.30%
Lassen	0%	0%	38.49%	56.77%	0.00%	1.05%
Orange	5.33%	71.88%	20.00%	6.25%	0%	0%
San Bernardino	1.38%	2.35%	3.27%	9.49%	74.56%	0%
Stanislaus	63.31%	7.89%	33.92%	30.70%	15.50%	0%

Figure 5: Overlay map of the California counties dividing the WorldCover map of the region's land cover

Acknowledgment

Dr. Rusanne Low, Ms. Cassie Soeffing, Mr. Peder Nelson, Dr. Erika Podest, Andrew Clark, Christopher Grizzaffi, & Bill Lam

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RESULTS

Running ANOVA we receive a p-value of 0.204662869 and our model utility test for all counties provides a p-value of 0.8738888892 both greater than our significance level of $\alpha = 0.05$, so we fail to reject the null hypothesis. There is not statistically significant evidence that West Nile Virus cases vary between the different income brackets from the 2020 Census.

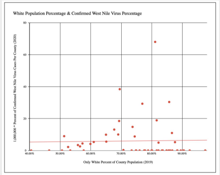

Figure 13: Scatterplot of white population percentage & confirmed West Nile Virus percentage for all counties along with the linear regression y=0.0202303191+4.504788 658

Running another model utility test on only counties that have confirmed West Nile Virus establishes a p-value of .0391891246 less than our significance level of 0.05, so we reject the null hypothesis. There is convincing statistical evidence of a moderate linear relationship between white population percentage and confirmed West-Nile Virus cases for counties with at least 1 confirmed West-Nile Virus cases.

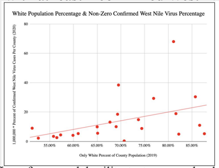

Figure 14: Scatterplot of white population percentage & confirmed West Nile Virus percentage for all counties along with the linear regression y= 0.597963359x+27.75961 643

All five of our model utility tests run on land cover resulted in extremely large p-values Therefore, we do not have convincing statistical evidence of a linear relationship between any of the types of land cover and percentage of confirmed West Nile Virus cases per county.

Land Cover	P-value	Reject or Fail to Reject	Correlation Coefficient	Equation
Built Up	0.8655957341	Fail to Reject	-0.1057583438	y = -0.0918295952 + 16.62622952
Tree Cover	0.4683764491	Fail to Reject	0.4313091848	y = 0.6703121649 + 2.288906412
Grassland	0.7835676783	Fail to Reject	0.1708199615	y = 0.198662839 + 11.01520168
Bare/Sparse	0.7021144617	Fail to Reject	-0.2361730316	y = -0.1679323635 + 20.58354189
Permanent Water Bodies	0.6864289442	Fail to Reject	-0.2488716071	y = -2.117053995 + 18.65148017

Figure 16: Summary of p-values, correlation coefficients, and equations for all five model utility tests run between types of land cover and percentage of confirmed West Nile Virus cases per county

DISCUSSION

Our research brings together both socioeconomic factors and statistical data to form several possible models and relationships. A 2021 study reflects that the mosquito *Anopheles stephensi* prefers type B blood, with over 70% of mosquitos being attracted by it (Khan, 2021), which is possible that as the white population increases the amount of type B- blood also increases, attracting more mosquitos, and resulting in more bites that could transfer West Nile Virus. Our land cover data fails to take into account how well maintained an area is. For example, built up land cover refers to areas that have been developed with buildings that could be worn down with exposed bodies of stagnant water that are used for mosquito breeding.Our research was designed and conducted to avoid possible error and bias, but our research is still subject to census bias due to the census is the most accurate source for our data.We also would like to acknowledge possible human error in analyzing our land cover data.

CONCLUSION

ANOVA confirms the socioeconomic factor of median household income appears to no effect on the spread of West Nile Virus. However, income most likely does still play a factor via the ability to afford better housing that reduces contact with mosquitos or other forms of vector control. Race has a moderate impact on the spread of West Nile Virus. We have established that as the percentage of whites in a county increases, so does the percentage of the population that contract West Nile Virus.Therefore, extensive medical training on West Nile Virus, better vector control, improved housing, insecticide, or another method should be concentrated on areas with high or increasing white populations. Land cover data has proved to have little implications into socioeconomics. However, as GLOBE Earth System Explorer Data continues to improve and is certainly a possibility to return to the model utility test to continue our research by developing land cover approximations for all 58 counties in California, allowing us more data points to work with and analyze with more socioeconomic factors such as employment and education, with the possibility of developing a theory on the intersectionality of these factors and the spread of West Nile Virus cases.

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