Age, Geographical Region, Population Density, and its Influence on Mosquito Source-Reduction Practice

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Abstract

With a reduction in the nationwide usage of Dichlorodiphenyltrichloroethane (DDT), mosquito populations are beginning to rise in certain regions as mosquito breeding "hotspots" are steadily becoming more prominent. While DDT proved to be effective in its duty of reducing the population of disease-carrying vectors, it is no longer being utilized as a control due to its adverse effects towards the environment. Now, multiple nations may consider the alternative of practicing breeding source-reduction. Water-filled sources left unchecked may be home to hundreds of larvae in a volume as low as half of a cubic meter. Allowing such breeding habitats to remain causes an uncontrolled number of mosquitoes to continue spreading vector-borne diseases. Therefore, educating the global population on mosquito breeding site source-reduction would prove to be an effective method for ensuring the continuity of mosquito control. In order to effectively educate communities on source-reduction, cross-examining the relationships between demographics, source-reduction practice, and other factors would allow for educational efforts to be more effective. Through a survey conducted of 429 people around the USA, we seek to identify trends of certain demographics that would benefit the most from source-reduction education programs

Research Question

How do different demographics in the United States, including age, geographical region, and population density affect the practice of source reduction? Using this data, how can educational efforts be most effective?

Introduction

As the usage of Dichlorodiphenyltrichloroethane (DDT) has declined to a halt, mosquito populations are beginning to rise greatly in "hotspots" in certain regions throughout the U.S. While DDT proved to be effective in reducing the population of disease-carrying vectors, it is no longer being used as a control due to its adverse effects on the environment (Thuy 2015). Source reduction, the removal of mosquito breeding sites, has been proven as an effective and safe way of reducing mosquito-borne diseases (Yohannes 2005). Despite this, the majority of the country has no knowledge of the practice. Stagnant water left unchecked may be home to hundreds of larvae in a volume as low as half of a cubic meter. Allowing such breeding habitats to remain causes an uncontrolled number of mosquitoes to continue spreading vector-borne diseases. With this, educating the global population on mosquito breeding site source reduction would prove to be the most effective and safe method for mosquito control. Similar to citizen science, the actions of willing individuals who are aware of source reduction could help reduce the rate of transmission of mosquito-borne diseases without the enormous sum of money typically required for the distribution of dangerous mosquito-eliminating chemicals that the insects eventually develop a resistance to. In order to effectively educate communities on source reduction, we cross-examined the relationships between demographics, source-reduction practice, and other factors to allow for targeted educational efforts which would improve the effectiveness of educational efforts. We sent out a survey to 429 people from around the United States with the goal of identifying trends in demographics that would benefit the most from source-reduction education programs.

Examples of containers with mosquito breeding sources found within the water in the container

Photo Credits: Hannah Clay

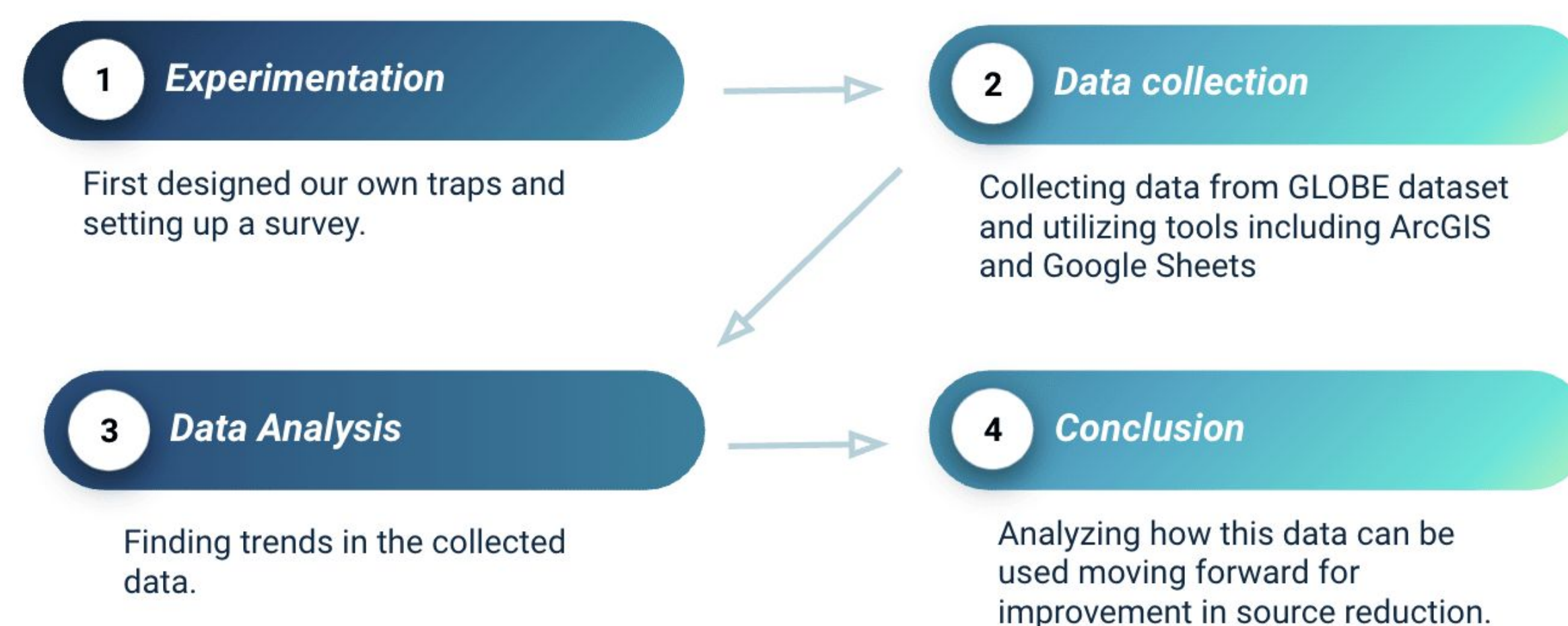Mosquito Egg Raft → Mosquito Larva → Mosquito Pupa

Photo Credits: Bill Lam

## Field Photos

Research Methods

Our team recognized a lack of knowledge pertaining to source reduction within the US, despite its clear benefits in reducing mosquito-borne disease transmissions without the environmental hazards of DDT. To combat this, implementing simple educational programs, such as flyers and posters, would be an effective way to raise awareness of source reduction, thus decreasing the population of mosquitos. However, not every community needs these education programs. To identify the demographic that would benefit the most, we conducted a survey with results from 429 people from all demographic groups (age, geographical region, population density) that communicated their knowledge of source reduction compared to how often they were bitten by mosquitos. ArcGIS data was used to examine GLOBE data collected by our fellow Mosquito Mapper interns (part of our NASA SEES internship) to identify where, geographically, people practiced source reduction the most. It is important to note that the data collected from the ArcGIS data was strictly from interns who were educated on the benefits of source reduction. Our survey was finely tuned to have a balance between getting all the information we wanted with also making it quick and easy to fill out, in order to get a variety of results from a variety of different sources.

Methodology

1. **Experimentation** — First designed our own traps and setting up a survey.
2. **Data collection** — Collecting data from GLOBE dataset and utilizing tools including ArcGIS and Google Sheets
3. **Data Analysis** — Finding trends in the collected data.
4. **Conclusion** — Analyzing how this data can be used moving forward for improvement in source reduction.

Results

We found that those who knew the definition of source reduction were over 25% more likely to practice it, as shown in the data figure below. This fact suggests a direct correlation between increased education of source reduction and its practice by citizens.

Practicing Source Reduction vs. Knowledge of Source Reduction
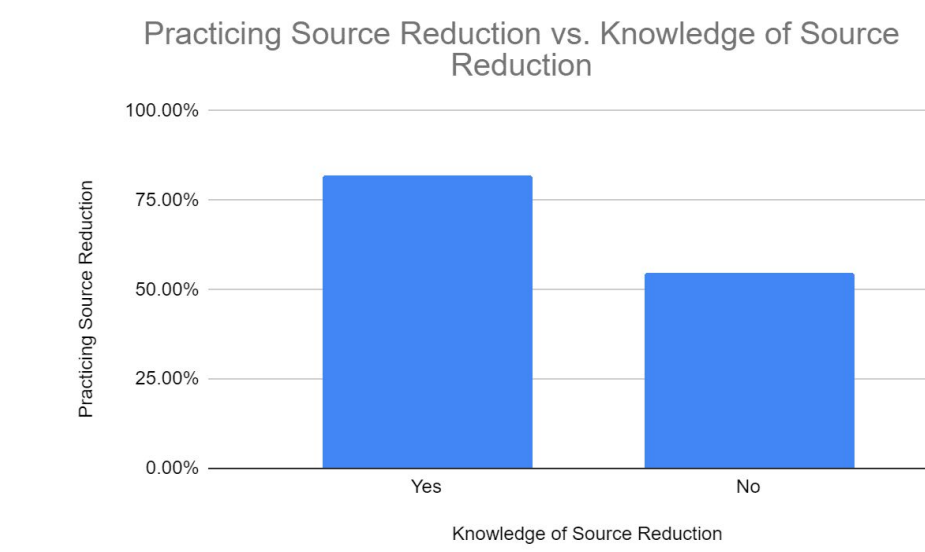
A similar result between knowledge of mosquito-borne diseases and the practice of source reduction has also been concluded. People who described themselves as "well-informed" on mosquito-borne diseases were over **25% more likely** to practice source reduction than those that described themselves as "ill-informed."

Source Reduction vs. Informed on Mosquito-Borne Diseases
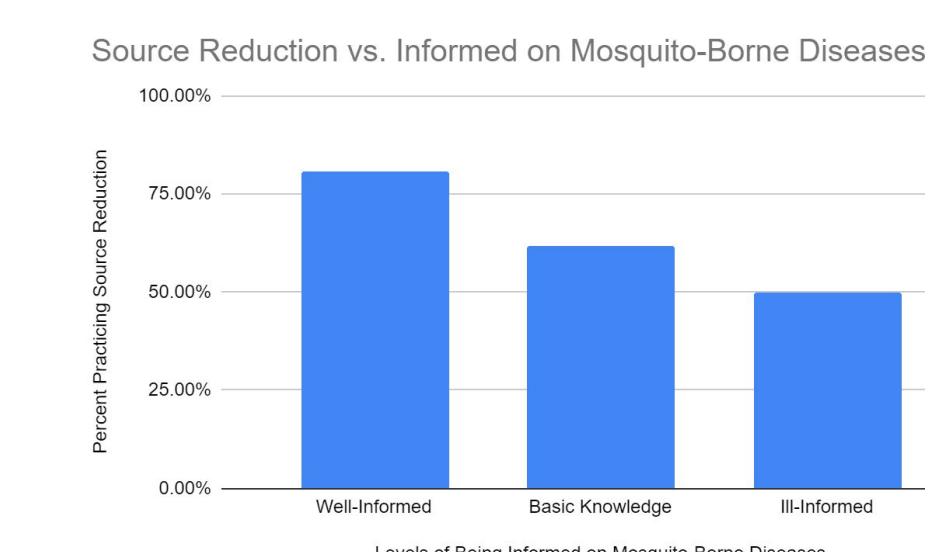
Geographical region and climate type proved to have influence on practice, where East Coast residents (particularly in the North-East) were **far less likely** to practice source reduction compared to west coast residents.

How Region Influences the Frequency of Source Reduction Practice
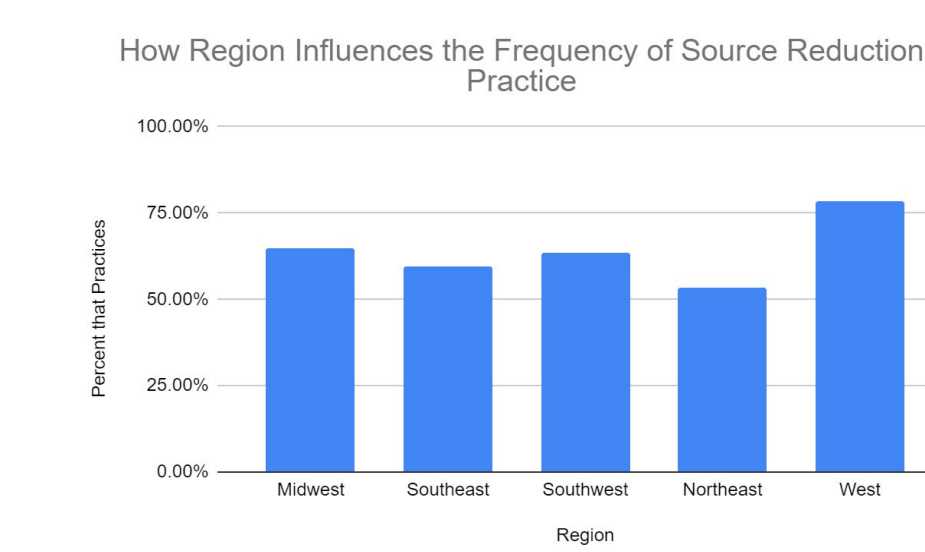
Age is a key factor in the percentage of those who practice source reduction. People aged 60 and older were **much more likely** to practice source reduction, likely due to more experience outdoors. Those aged 18-25 were more than **25% less likely** than all of the other age groups.

Percent that Practice vs. Age Range
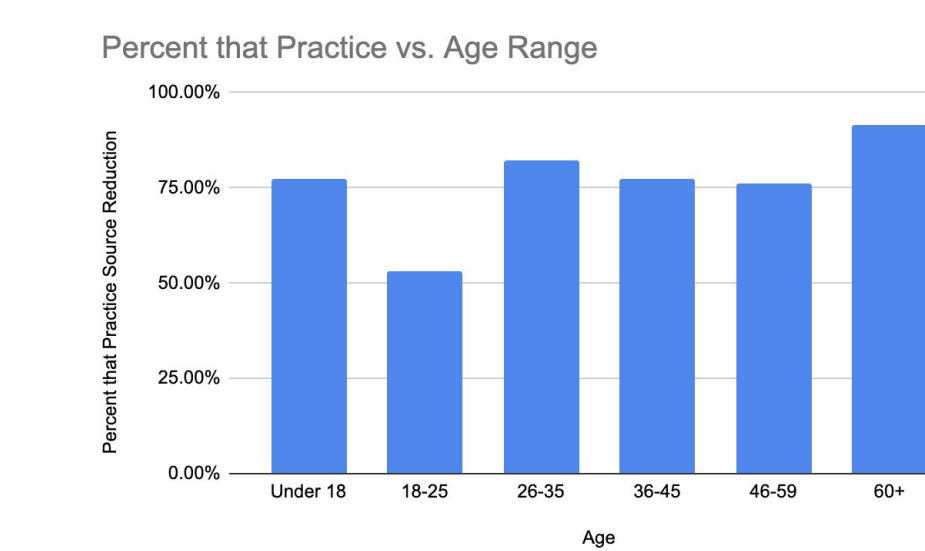
On ArcGIS, this can be shown by observing the numbers on the East and West coast cities. San Francisco depicts a 1 to 1 ratio between those who eliminate their breeding sources and those who do not, whereas looking at New York City, a much larger number do **not** practice source reduction compared to those that do.

Breeding ground eliminated
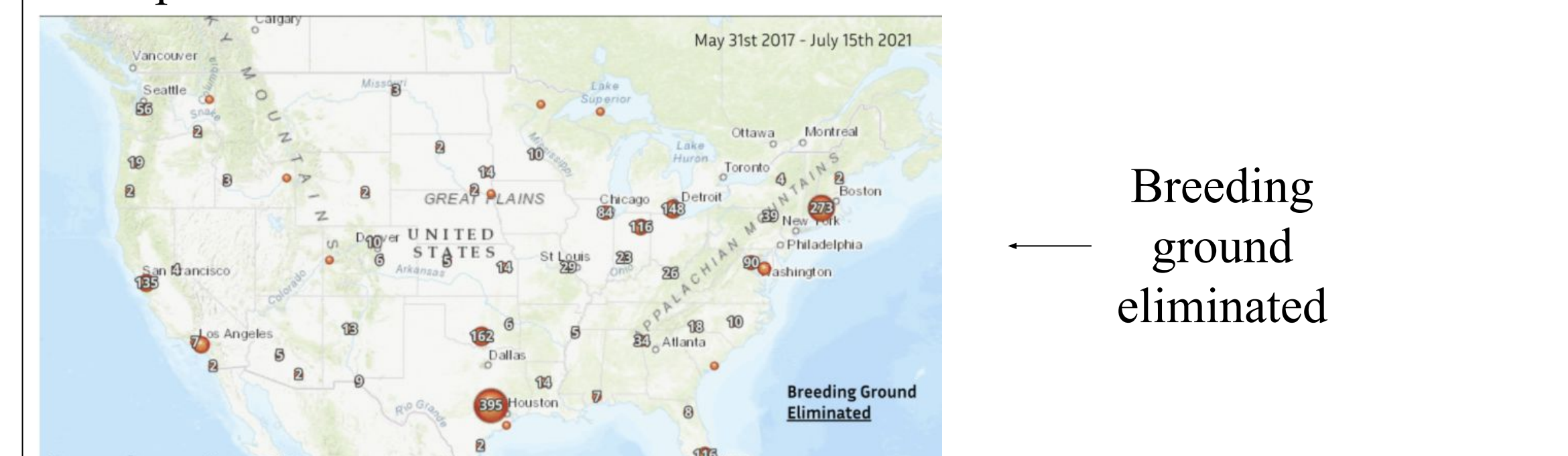
Breeding ground NOT eliminated
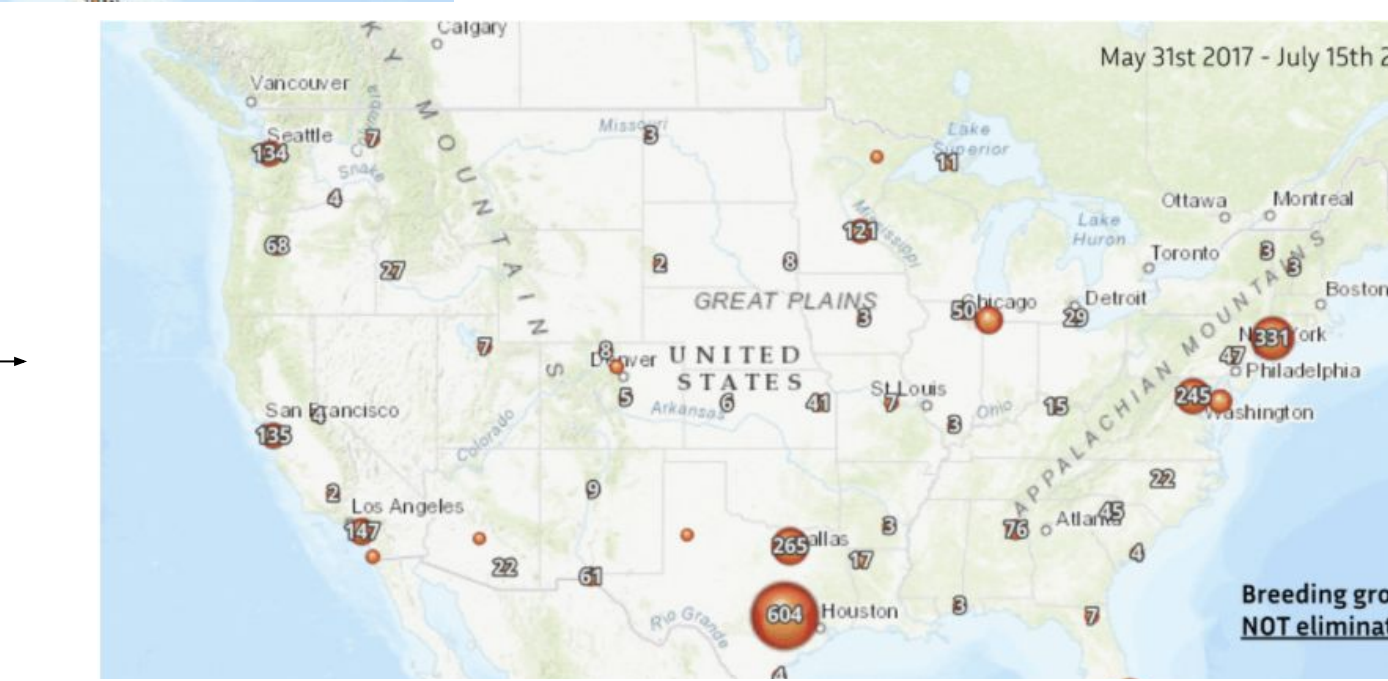
Discussion

While our team was happy with the number of responses we received, the data could have been more accurate with a wider variety of ages. Due to our age and method of distributing the survey, we received a large number of participants under the age of 18. While this is important knowledge to have, it would be more precise to have a balanced mix of age groups. In the future, our team would love to create another survey with more fine-tuned questions and specific definitions of source reduction to improve the accuracy of results. We reached out to people primarily of a younger age (largely under the age of 18), so conducting another survey with participants of all ages equally represented would improve the accuracy of results as well. Contacting and working together with public health officials would be the next step in implementing source reduction around the country, as we have found the demographics that would benefit the most from educational programs on source reduction but have limited knowledge in educational practice. Combining our data with that of how to most effectively teach those who need the knowledge would be the next step in increasing the practice of source reduction. We believe this is a simple solution that will prove to be the most effective way to decrease the mosquito population in the United States without harsh chemicals. Expanding this research to other countries could prove effective in learning which demographic needs more education.

Conclusions

The trends found were highly beneficial and painted a clear picture as to what demographics would benefit the most from education on source reduction. Public health officials would be interested in the data that our group gathered since, without DDT, mosquito source reduction is one of the easiest and most reliable methods of eliminating mosquitoes and vector-borne illnesses (Yohannes 2005). A relationship was found between educating about source reduction and practicing source reduction, thus showing that implementing educational campaigns in the demographics found by our survey would be a major tool in reducing the number of mosquitoes in these areas. This would subsequently slow the spread of vector-borne disease in these regions. The largest impact of these educational efforts would be seen if the campaign was focused in urban environments located in the North-East for people ages 18-25. While most educational efforts are focused in schools (Beams 1986), based on our findings it would be most effective to create programs in colleges and other places frequented by 18-25 year olds. However, if even basic information is given to people throughout the nation, it would make a monumental difference in controlling mosquito populations and neutralizing vector-borne diseases. This could be done in a variety of ways: by making it a mandatory part of high school health class curriculum, townships holding free information sessions, etc, and would hopefully see a decrease in cases and deaths that occur due to vector-borne disease.

Bibliography

- Thieu Thi Thuy. 2015. Effects Of DDT On Environment And Human Health. Journal of Education and Social Sciences, Vol. 2, (Oct.)
- Yohannes, M., Haile, M., Ghebreyesus, T.A., Witten, K.H., Getachew, A., Byass, P. and Lindsay, S.W. (2005), Can source reduction of mosquito larval habitat reduce malaria transmission in Tigray, Ethiopia?. Tropical Medicine & International Health, 10: 1274-1285. https://doi.org/10.1111/j.1365-3156.2005.01512.x
- Beams BF. Analysis of mosquito control agency public education programs in the United States. J Am Mosq Control Assoc. 1985 Jun;1(2):212-9. PMID: 3880232.
- ArcGIS Mosquito Mapper Data

Acknowledgements