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

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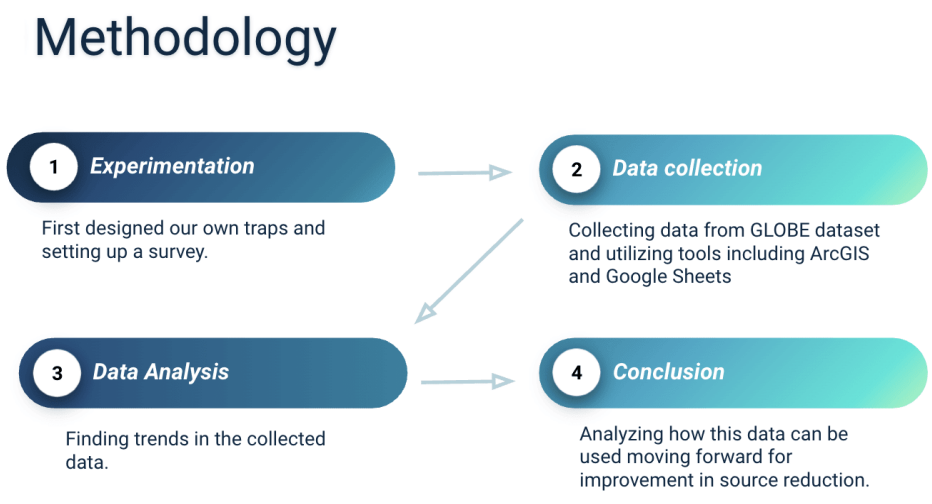
Introduction:

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 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 a cubic meter. Allowing such breeding habitats to remain causes an uncontrolled number of mosquitoes to continue spreading vector-borne diseases. Due to this, we believe that 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 citizens who are aware of source reduction could help eliminate mosquito-borne diseases without the millions of dollars that are 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

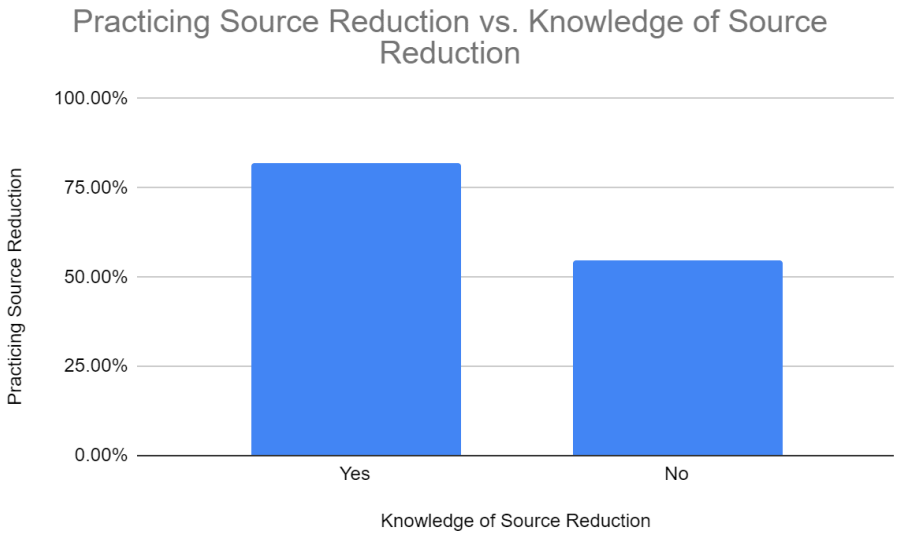
the United States with the goal of identifying trends in demographics that would benefit the most from source-reduction education programs. Our team identified a lack of knowledge about source reduction within the US despite its clear benefits in eliminating mosquito-borne diseases.

Methods:

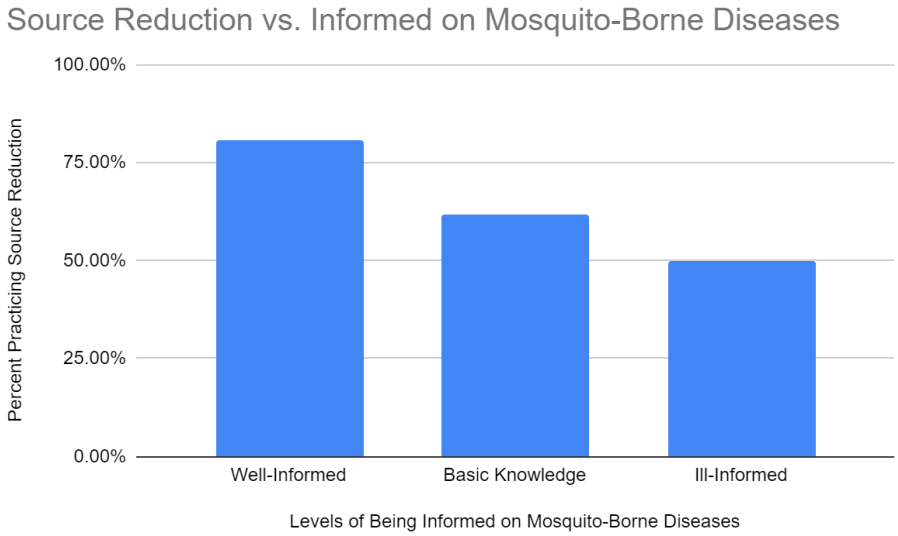
To combat this lack of knowledge, implementing simple educational programs, such as flyers and posters, would be an effective way to raise awareness of source reduction, thus decreasing the population of mosquitos. However, not every community needs these education programs. To identify the demographic that would benefit most, we surveyed 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.



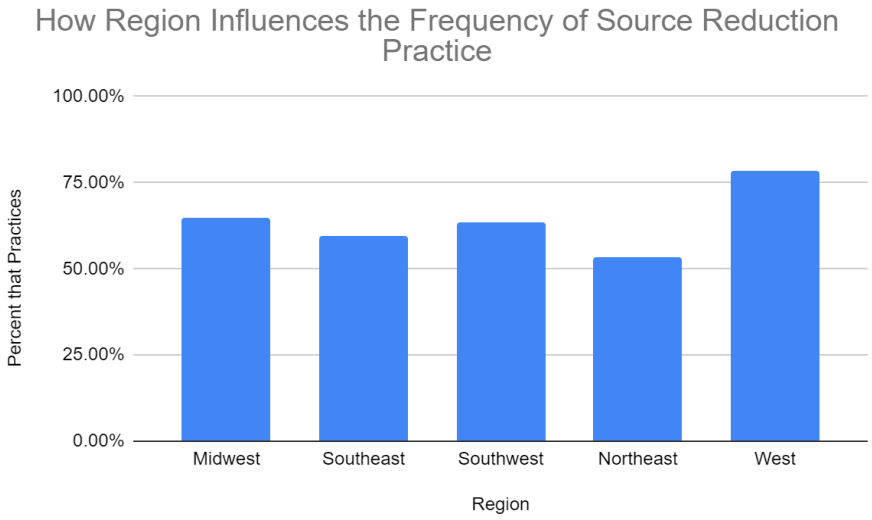
We found that those who knew the definition of source reduction were over 25% more likely to practice it, as shown in the data below. This directly proves that education is an effective way of increasing citizen practice of source reduction.



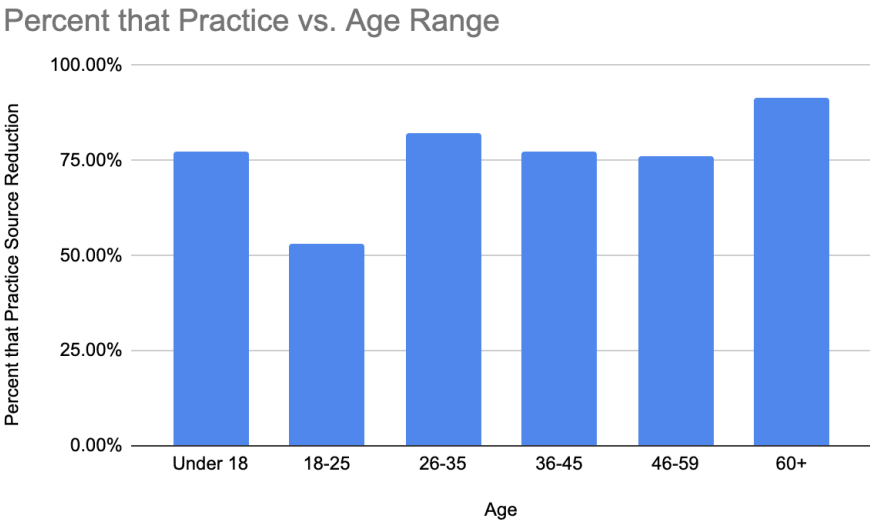
There was a similar result between knowledge of mosquito-borne diseases and the practice of source reduction. People who described themselves as "well-informed" on mosquito-borne diseases were also over **25% more likely** to practice source reduction than those that described themselves as “ill-informed."



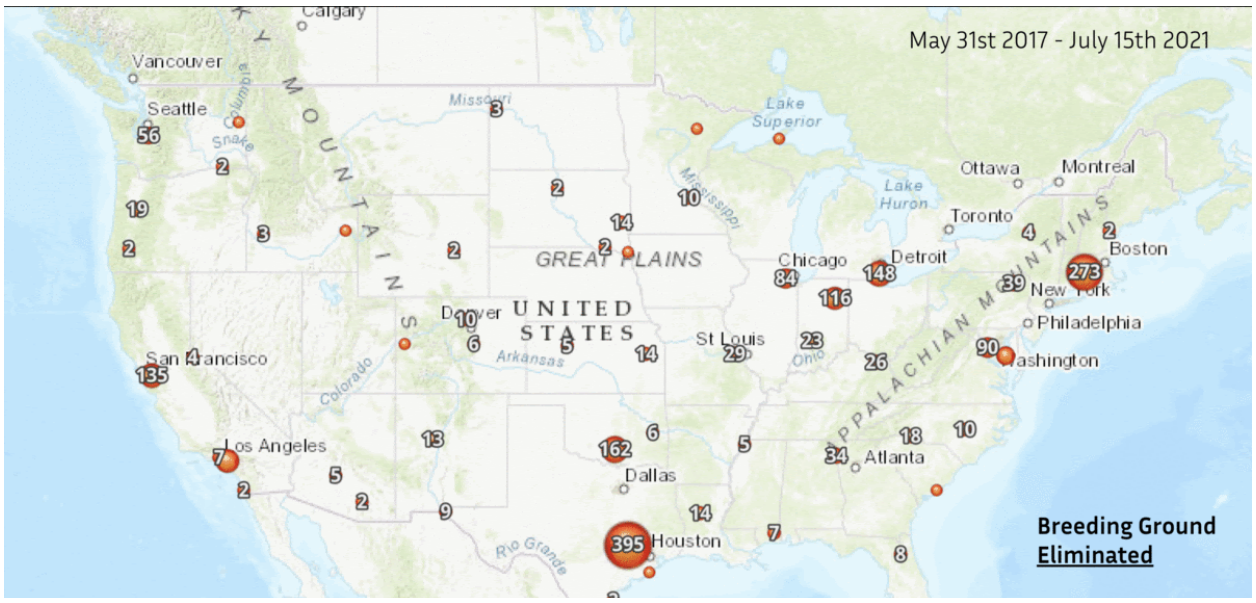
Geographical region and climate type also played a role, with East Coast residents (particularly in the Northeast) **far less likely** than West Coast residents to practice source reduction.



Age is also 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 in nature. Those aged 18-25 were more than **25% less likely** than all of the other age groups.



Using GLOBE data from the Mosquito Mapper program and ArcGIS, this can be shown by observing the numbers on the East and West coast cities on the map below. San Francisco shows 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.



Conclusion:

The trends we found were promising and paint 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 mosquitos 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 focused on urban environments located in the Northeast 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.

Improvements

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 programs.

Badges:

Be a Collaborator

For our research, we were faced with the challenge of being fully virtual and living in different time zones and geographical regions. We were all brought together by the 2021 NASA SEES internship and found not only promising results in our research but a lasting and fulfilling friendship as well. Using GLOBE satellite data, ArcGIS geo-mapping, citizen science, and surveys, we were able to collect data to paint a clear picture and draw a solution to our research question. Even after our group meetings to discuss results ended, we held game nights and team bonding activities that worked phenomenally in bringing us together and working more efficiently together. The two people who lived in close proximity with each other, Hannah and Imron, were able to collect field data together to better our research. Coco was most proficient at using Google Forms and doing data analysis, so she took the lead on this. We all have had different life experiences and different talents, so bringing the team together worked amazingly well.

Sylvie Wurmser (Montclair High School, Montclair, New Jersey) - Primary author of report and poster, supporting data analyst, team leader

Coco Nate (North Central High School, Indianapolis, Indiana) - Primary data analyst, survey creator, supporting author

Bill Lam (Oakton High School, Vienna, Virginia) - Supporting author, supporting data analyst, team organizer

Amalia Nevarez (Arizona School for the Arts, Phoenix, Arizona) - Supporting author, head editor

Imron Bouley (Brandeis High School, San Antonio, Texas) - Supporting author, field data collector, editor

Hannah Clay (Health Careers High School, San Antonio, Texas) - Supporting author, field data collector

Smriti Jasti (Round Rock High School, Austin, Texas) - Supporting author

Be a Data Scientist

Our project is data-focused and our findings were in the form of statistics which represented those who would benefit the most from education. In order to find accurate data, we spoke to local statistic teachers as well as psychology teachers to avoid unintentional bias in the data. We also made a deliberate attempt to increase the number of responses we would receive by making the survey a perfect "goldilocks" length which would get the maximum amount of information while still keeping it short enough to not be a burden. We identified a potential issue with our data in that a disproportionate percentage of those who filled out the survey were children–below the age of 18–which we are aiming to change for future research.

Be a STEM Professional

We had the privilege of working with a variety of STEM professionals when conducting our research. We first began with Dr. Russanne Low, who specializes in earth-science research. She offered us invaluable information not only in how to conduct our findings, but additionally connected us to further scientists such as Dr. Allison Parker. Dr. Low also helped us with research etiquette and this experience was a first for everyone on the team. We then talked with Dr. Parker, who helped us develop our survey with more thought-provoking questions that would

provide the most reliable data possible. She informed us what types of data would be most helpful for her, and we formed our research around that.

Acknowledgments:

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For any questions on research, please contact sylvieswurmser@gmail.com

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