Distribution and abundance of mosquitoes in the world. Preliminary report

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Abstract

Based on the data collected around the world by the GLOBE Program, an analysis was made of the distribution and abundance of larvae according to latitude, elevation, and type of habitats, comparing them with climatic conditions. Samplings were also carried out in the Patagonia region, with extreme climates for the development of mosquitoes. The GLOBE mosquito protocol and the GLOBE Observer-Mosquito application were used. Habitats were recorded and larvae were identified. The statistical treatment was performed ANOVA and the Tukey test of difference of means. Landsat 8 images were analyzed from the calculation of NDVI and NDWI indexes in the Junín de los Andes area. The greatest abundance of mosquito larvae was found in latitudes and low elevations, coinciding with high temperatures, abundant rainfall and high humidity. The largest number of larvae was recorded in artificial containers thrown as garbage, which would indicate that human behaviors influence the abundance of mosquitoes. In the Patagonian region there is less abundance of mosquitoes than in low latitudes due to low temperatures and the dry season in summer and autum.

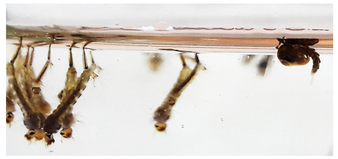
Research Question

Asking Questions

1) At what latitudes and altitudes will a greater number of mosquito larvae be found?
2) What habitat preferences do mosquito females have to lay their eggs?
3) How does human behavior influence the distribution and abundance of mosquitoes in the world?
4) Which species are more abundant in the world?
5) Why are there no mosquitoes in some places? 5) With climate change will changes in temperature, humidity and rainfall patterns occur, will they influence the abundance and distribution of mosquitoes?

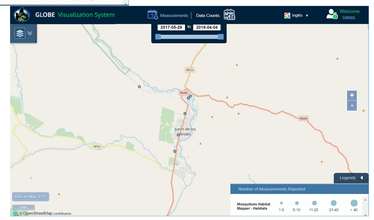
Introduction

Mosquitoes are vectors of diseases that cause many deaths in the world. It is considered the most dangerous animal in the world.
Warm areas with high humidity and rainfall have a greater abundance and diversity of mosquitoes.
Mosquitoes reproduce in natural and artificial habitats. The human behaviors of discarding containers that retain water provide new habitats for the reproduction of mosquitoes.
Risk maps are prepared to alert the population about diseases caused by pathogens transmitted by mosquitoes.
The transport of people and goods on a global scale generates a way of mosquito dispersion.
Climate change could cause changes in the distribution of mosquito species and diseases. (Wu, et al., 2016)



Research Methods

The GLOBE Program data, taken in a large part of the world by students, teachers, scientists and citizen scientists from the following available periods, were used: a) Mosquito Larvae (2015/10/04 to 2018/11/26), 465 sites sampled. b) Mosquito habitat mapper (2017-05-29 to 2019-04-03), with 3792 sites sampled. (NASA-GLOBE, 2017). To analyze the data of mosquito larvae, they were divided into ranges from 0 to 600 larvae and greater than 600 because of the great variability in abundance in some regions.
Samples were taken in the surroundings of the city of Junín de los Andes, Argentina in different places, where there were small bodies of standing water parallel to the Chimehuin River. Period from 2019/26/02 to 2019/11/03. Traps for mosquitoes were also placed in order that the females place their eggs there.
For the sampling and identification methodology, the GLOBE Program Mosquito protocol and the GLOBE Observer application (NASA-GLOBE, 2017) were used.
The samples were processed to perform the mosquito count and identify the genus. Some pupae were preserved until the adults emerged to identify them and make a photographic record.
Statistical analysis was performed with STATISTICA software. To test for normality, we used the tests (Shapiro-Wilk, Kolmogorov-Smirnov, Lilliefors), then the analysis of variance (ANOVA) was applied, homogeneity of the variance was checked with the Levene test and comparison of means was performed by applying The Tukey Test.
The historical climatic data of Junín de los Andes and the meteorological data of the sampling period were obtained from the Meteoblue website. The Landsat 8 OLI satellite images from the Junín de los Andes area were obtained from the EarthExplorer database and processed with the QGIS software. The indices were calculated: a) Normalized Difference Vegetation Index (NDVI) and b) Normalized Difference Water Index (NDWI)



GLOBE Badges

Be a **Data Scientist**
The report includes in-depth analysis of students' own data as well as other data sources. Students discuss limitations of these data, make inferences about past, present, or future events, or use data to answer questions or solve problems in the represented system. Consider data from other schools or data available from other databases.

Make an Impact
The report clearly describes how a local issue led to the research questions or makes connections between local and global impacts. The students need to clearly describe or show how the research contributed to a positive impact on their community through making recommendations or taking action based on findings.

Be a **STEM Professional**
The report clearly describes collaboration with a STEM professional that enhanced the research methods, contributed to improved precision, and supported more sophisticated analyses and interpretations of results.

Results

In the world data analyzed it is observed that the largest number of mosquito larvae are found in artificial containers.
The greatest number of larvae was found in low latitudes, coinciding with humid tropical climates and with distribution maps of mosquito-borne diseases. The number of mosquito larvae decreases with altitude. In the lower areas there is the greatest abundance.
16% of the habitats sampled in the world by the participants of the GLOBE Program did not contain mosquito larvae.
In the area sampled near Junín de los Andes, the climate is cold and dry. It is a transition zone between the forest and the Patagonian steppe. The rains are concentrated at the end of autumn and winter, coinciding with the minimum temperatures. In summer only some days record temperatures higher than 25 ° C.
In the samplings carried out, no larvae were detected in four sites of natural habitats with still water. Most of the possible habitats, both natural and artificial, were without water, due to the dry season. In the other sites, larvae of the Culex genus were detected in different amounts. All in natural environments. The presence of adult mosquitoes is also scarce.

Figure #1

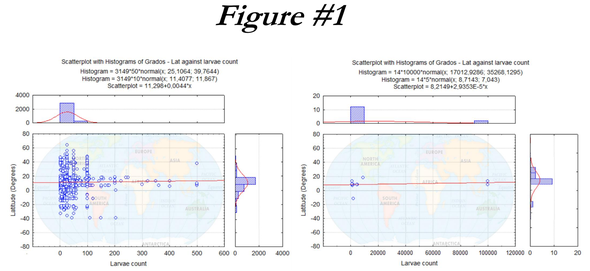


Figure #2

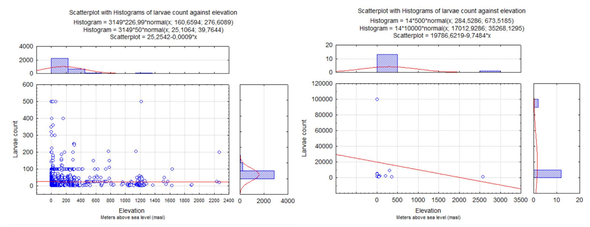
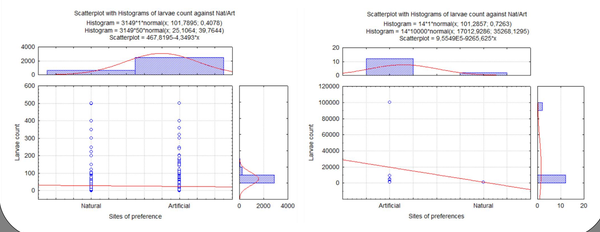


Figure #3



Discussion

Because it is a preliminary report in future investigations, it is important to deepen the investigation to corroborate the conclusions obtained. For a better knowledge of the ecology of each genus of mosquitoes in different parts of the world, a systematic monitoring is suggested, at least once in each station in similar coordinates. This would allow knowing the impact of climate change and human behavior. It would also help to develop better predictive models of disease outbreaks.
In areas where mosquitoes are scarce or with extreme climatic conditions such as in latitudes and medium and high elevations it would be interesting to expand the sampling effort to know the limiting factors and the adaptations of the species to extreme climatic conditions of temperature, desiccation, survival of the eggs, and others. This knowledge could contribute to improve management plans and prepare to mitigate the effects of climate change on the transmission of mosquito diseases.

Conclusions

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