Comparison of water quality of the Chimehuín river with that of nearby puddles with mosquitoes

Age team members: **17-18**

Number team members: **3**

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The StarT theme to which the project is linked: **My LUMA**

Project diary

The problem

Mosquitoes cause millions of deaths every year worldwide, due to their ability to transmit and spread diseases to humans (WHO, 2020). Eg In 2017, an estimated 219 million cases of malaria (also called malaria) occurred in the world. It is estimated that it is the most dangerous animal in the world because of the number of deaths it causes per year. (Weetman, et al., 2015; Blasberg, et al., 2016; Bissinger, et al., 2014).

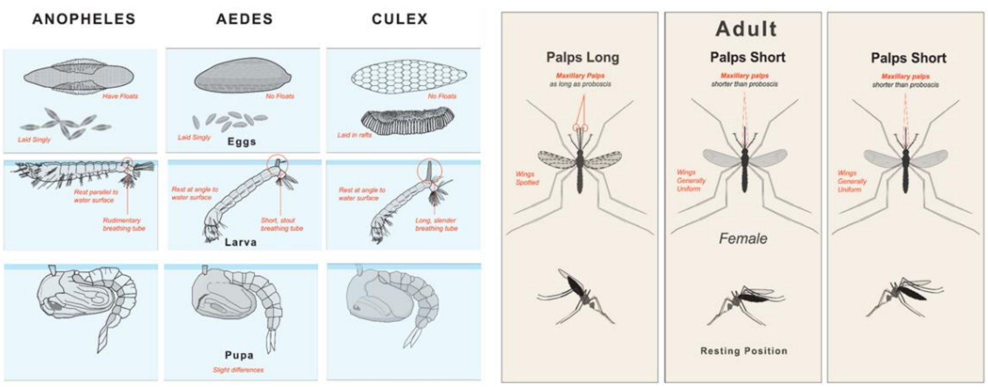

Fig. 1. Main differences between mosquito genera. Source: The GLOBE Program

Mosquitoes (Fig. 1) that cause various diseases because they are vectors of viruses, bacteria and parasites. The global incidence of dengue has multiplied by 30 in the last 30 years (Lam, et al., 2012), and more countries are reporting their first outbreaks of the disease. Zika, dengue, chikungunya and yellow fever are transmitted to humans by the Aedes aegypti mosquito. Due to the distribution of people in the world, it is estimated that more than half of the world's population lives in areas where the Aedes mosquito is present.

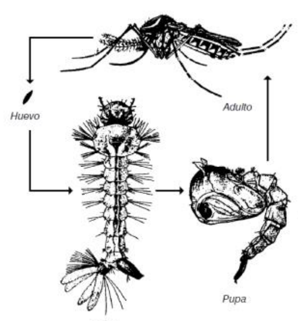

Fig. 2. Life cycle of mosquitoes. (Rossi & Almirón, 2004).

Table 1. Main diseases transmitted by mosquitoes

Genus of mosquitoes	***Transmitted diseases***	
Aedes	Chikungunya Dengue Lymphatic filariasis Rift Valley fever Yellow fever Zika	Dirofilaria immitis Fever of the Ross River Barmah Forest virus La Crosse encephalitis Keystone virus
Anopheles	Malaria or Malaria Lymphatic filariasis Dirofilaria immitis	
Culex	Japanese encephalitis Lymphatic filariasis West Nile fever Dirofilaria immitis	Encephalitis of Saint Louis Western equine encephalitis virus Fever of the Ross River Barmah Forest virus
Psorophora	Dirofilaria immitis	
Mansonia	Dirofilaria immitis	
Culiseta	Western equine encephalitis virus Eastern equine encephalitis virus	

Although mosquitoes are distributed around the world, in areas where there is a higher temperature and humidity, we can find more mosquitoes and species diversity.

The geographical distribution of mosquitoes is influenced by two major factors: a) habitat modification and b) active dispersal. The latter is the displacement of the mosquito in search of suitable breeding grounds, it has been detected that some species could fly up to 300 km and 9-hour flights (Huestis, et al., 2019). As for habitat modification, it covers more factors by which the mosquito is distributed; from climatic causes to anthropic intervention. (Fig. 3 and 4)

Risk maps of mosquito-borne diseases are used showing spatial heterogeneity and the probability of transmission on a global scale due to the intense transport of people and commoditys. (Fig. 3)

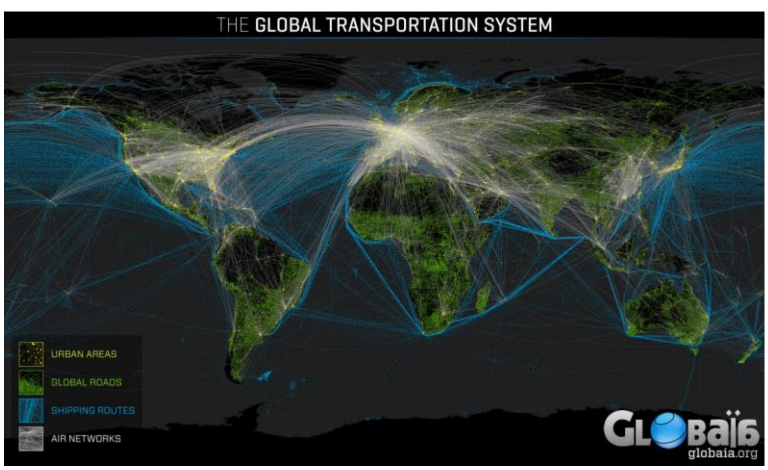

Fig. 3. Global transport system. (Globaïa, 2020)

Some mosquito eggs can withstand drying and extreme temperatures for months or even a year. These characteristics allow them to take advantage of human transport (Fig. 3) for passive dispersion over long distances.

Climatic conditions, in particular temperature, humidity and rainfall, affect mosquito breeding rates and survival, as well as habitat availability, impact their distribution and abundance.

The equatorial zone between the tropics has higher temperatures, rainfall and humidity than the middle and high latitudes. The same goes for altitude, as we ascend the temperature decreases. Other factors such as proximity to the ocean, continental development, etc. also influence.

With the climatic change an increase of the global average temperature has been observed, as well as loss of sea ice, thinning and loss of glaciers at the poles and in high mountain areas that are causing changes in the climatic patterns of different regions. In some sites there are changes in temperature and rainfall, higher frequencies of extreme events, changes in the flora and fauna of ecosystems and other effects.

These changes can affect the distribution and abundance (Fig. 5) of insects such as mosquitoes or pathogens that transmit both at higher latitudes or at higher altitudes. (Wu, et al., 2016). Temperature can affect the distribution of a disease by affecting the mosquito's life cycle. They need a certain temperature range to survive and develop. For example, a maximum temperature of 22–23 ° C and a minimum temperature of 25–26 ° C are the two thresholds for the development of mosquitoes that transmit the Japanese Encephalitis Virus (Mellor and Leake, 2000).

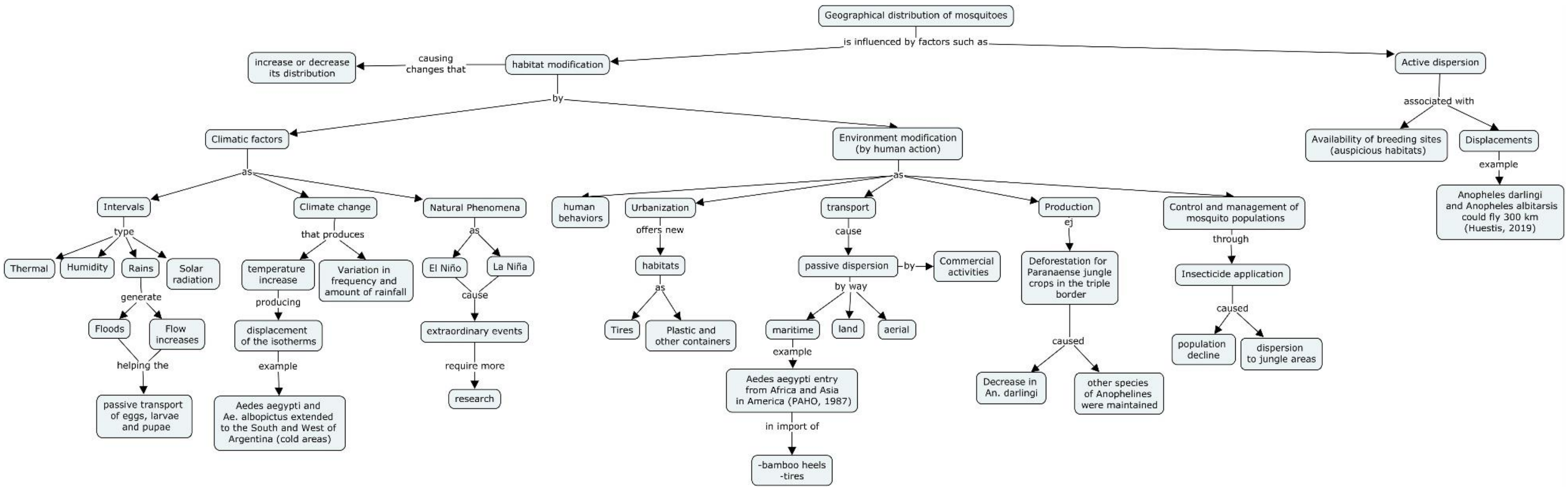

Fig. 4. Concept map of the geographical distribution of mosquitoes.

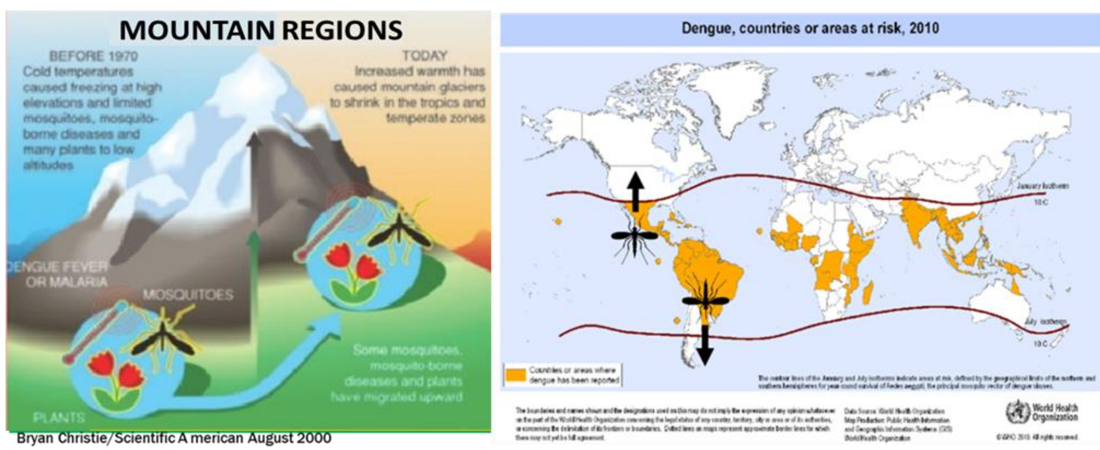

Fig. 5. Possible changes in the geographical distribution of mosquitoes due to climate change

Excessive heat can increase the death rates of some pathogens. For example, the development of the malaria parasite (Plasmodium falciparum and Plasmodium vivax) ceases when the temperature exceeds 33° C - 39° C (Patz, et al., 1996). In addition, the increase in temperature can influence reproduction and the incubation period. For example, P. falciparum reduces its incubation from 26 days at 20° C to 13 days at 25° C (Bunyavanich, et al., 2003).

Recent studies have found that some vector-borne human infectious diseases, such as malaria, yellow fever and dengue fever have been distributed to a wider range (for example, Harvell et al., 2002).

Environmental factors, such as temperature, dissolved oxygen, conductivity and pH can affect the number of mosquito predatory macroinvertebrates and the larvae that are their prey (Dida, et al. 2015). These fluctuating abiotic factors affect predators and prey differentially (Anderson et al. 2001). Understanding the biological limits of mosquito species to abiotic factors, as well as the structure of their habitat in environmental gradients, can provide useful information to develop biological control plans for mosquito larvae.

Research questions:

What are the physicochemical characteristics of mosquito habitats in puddles parallel to the Chimehuín River?

What differences exist between the physical-chemical parameters of river water and puddles with mosquitoes?

What macroinvertebrate differences are found in the Chimehuín River and in the parallel puddles?

Day 1 y 2:

Search for information on mosquitoes (species, diseases, geographical distribution, habitats, climate change, etc.).

Information search on types of mosquito traps

Day 3 y 4:

Search for water quality information in freshwater rivers. Macroinvertebrates as indicators of water quality. Effects of climate change on high mountain rivers.

Day 5:

Research design, sampling sites and research plan.

Day 6:

Sampling on the Chimehuín River (River 1) and in a parallel puddle (Puddles 1 and 2)

Sample Processing: a) Water quality analysis of the river and puddles: temperature, pH, turbidity, conductivity, alkalinity, dissolved oxygen. b) Identification and quantification of macroinvertebrates. Calculation of percentage of dominant taxon and EPT (ephemeroptera, plecoptera y trichoptera).

Note: EPT indicates the percentage of species sensitive to changes in water quality.

Fig. 6. Mosquito sampling

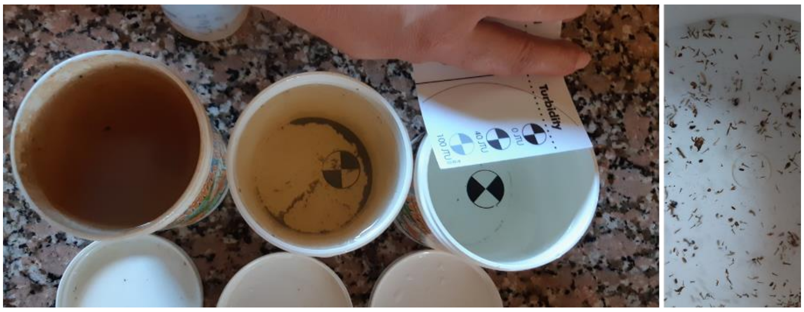

Fig. 7 Turbidity in puddle 1, puddle 2 and river. Right: mosquito larvae

Day 7

Fig. 8. Traps in urban environments (above) and in natural environments (below)

Construction of different types of mosquito traps: a) water, b) yeast water, c) ground beet water.

Placing mosquito traps in natural and urban environments

Day 8

Sampling on the Chimehuín River (River 3) and in a parallel puddle (Puddle 3)

Fig. 9 Puddle sampling 3 and nitrate analysis.

Sample Processing: a) Water quality analysis of the river and puddles: temperature, pH, turbidity, conductivity, alkalinity, dissolved oxygen. b) Identification and quantification of macroinvertebrates. Calculation of percentage of dominant taxon and EPT (ephemeroptera, plecoptera y trichoptera).

Inspection of mosquito traps to see if larvae are present.

Day 9:

Idem anterior with river 4 and puddle 4.

Fig. 10. River sampling and pH analysis

Day 10:

Data Processing. Preliminary conclusions

Day 11 – Project Product 1/2 ([Research report]())

Research report writing.

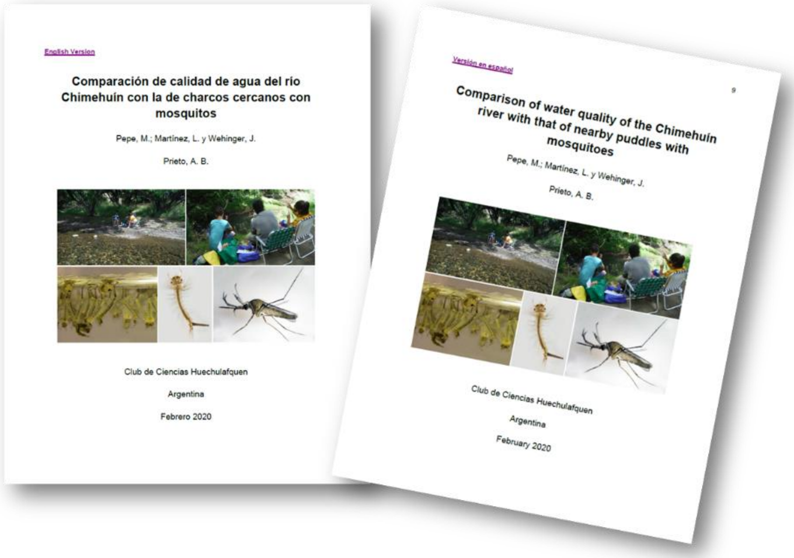

Fig. 15. Report of the investigation carried out. Report in pdf format, in bilingual version (Spanish/English).

Day 12 - Project Product 2/2 (Video research report)

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