

# Comparative Study of Water Quality Levels Before and After Drought of Two Streams in San Juan, P.R.

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## INTRODUCTION

Water is the most important resource in the universe and the most essential liquid for all forms of life, nevertheless the most threatened, too. This invaluable resource is threatened by different sources of pollution; which affect the quantity and quality of the water, and therefore the basic and multiple needs associate with it. The Caribbean island of Puerto Rico (population 3.8 million) is located in the humid tropics and received an average annual rainfall of 1500 mm at the 12 stations with the longest period of record (Brett Israel 2010). Rivers and streams serve many functions; however, they are one of the water bodies most vulnerable to pollution<sup>[4]</sup>. Some of the factors that tend to affect streams are climatic conditions, agriculture and contaminating effects of industrialization. The alteration of stream habitats by industrialization is widespread due that now people tend to destroy nature to construct new buildings and establish industries. These changes not only affect the stream's surroundings but also have a strong impact on the water quality.

There are many definitions and types of drought. Meteorologists generally define drought as a prolonged period of dry weather caused by a lack of precipitation that results in a serious water shortage for some activity, population, or ecological system. Drought can also be thought of as an extended imbalance between precipitation and evaporation (Schwarzenbach, 2010)<sup>[4]</sup>. The tropical island of Puerto Rico has been scrambling for a precious resource: clean, fresh water. Puerto Ricans have faced the worst drought in more than 20 years and the most stringent water rationing ever imposed.

Through this research several physical, chemical and biological parameters were used to determine water quality. To compare water quality changes in two streams before and after drought, Total Suspended Solids (TSS), Total Phosphorus (TP), water temperature and macroinvertebrate abundance and richness, were measured in a rural and urban stream. These comparison were taken through a two-year period from 2010-2012, with 2010-2011 data retrieved from "The effect of temperature over macroinvertebrate abundance of two streams in San Juan, Puerto Rico" (Rivera & Rosario, 2011) and 2011-2012 data retrieved from "Two-year comparative study of water quality levels of two streams in San Juan, Puerto Rico" (Rosario & Torres, 2012)

This study will facilitate observing and understanding the effect of drought and how contamination continues to rise on in both streams. Water quality is an issue of growing concern as global demand for water increases and freshwater resources become increasingly scarce. <sup>[2]</sup>

## HYPOTHESIS

Water quality and macroinvertebrate diversity in both streams will be lower in 2015 compared to 2010- 2012 data due to ongoing construction in nearby areas of these streams and the drought that occurred in 2015 .

## JUSTIFICATION

In recent years, there has been an increased concern about environmental problems caused by human activity. Knowing the quality of even the smallest of streams is important because all of our river systems connect to make watersheds; if a small stream is contaminated, as it heads downstream, it will affect every other body of water it comes into contact with. Good quality water in out streams can result in a healthier food chain, starting with the macro invertebrates that inhabit it. Contaminated water results in a lower quantity of macro invertebrates which consequently leads to a weak food chain that will affect us in the long run. If water quality is degraded, the stream or whichever water body it is, it may lose its value as a resource, and the environment around it will be affected. Weather can affect the quality of the water, in these case droughts. The reason this investigation team has decided to take on this research project to try to see how drastically these streams have been affected by the past drought; this way they can demonstrate and confirm the negative impact that not taking care of water bodies while in drought can lead to; hopefully, help spread knowledge of how important even the smallest of streams can be to the community and the environment.

## EXPERIMENTAL DESIGN

This research is based on the comparison of two streams in 2010-2011 and 2015-2016. The streams are Riveras Stream (PN\_RivStrm\_154) and Señorial Stream (PN\_SenStrm\_49) an urban stream. Both streams are located in San Juan, P.R.

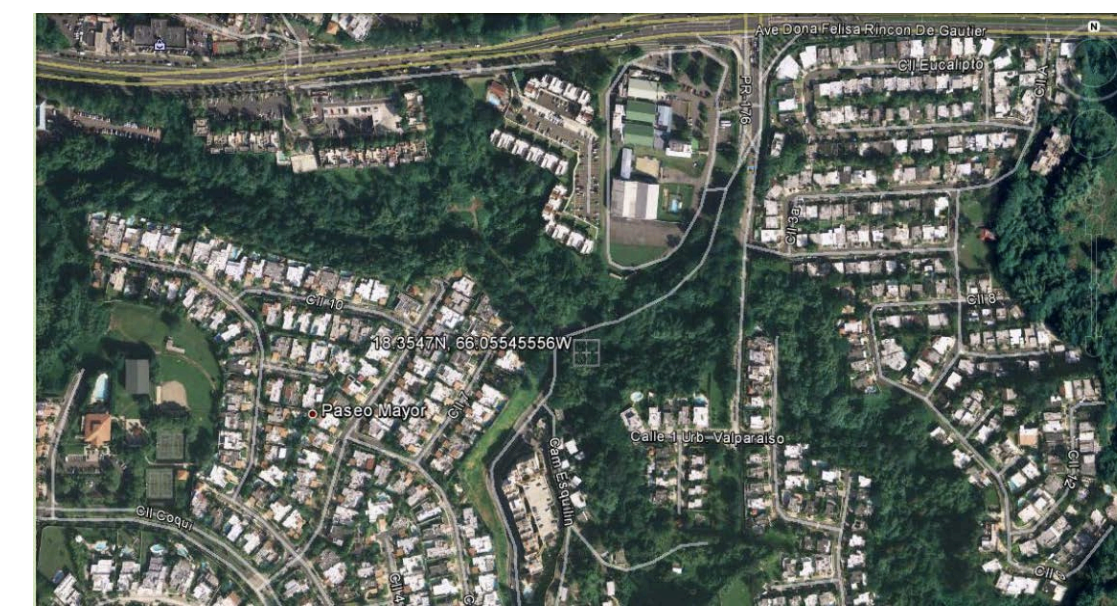


Figure A: Riveras Stream 2010



Figure B: Riveras Stream 2015

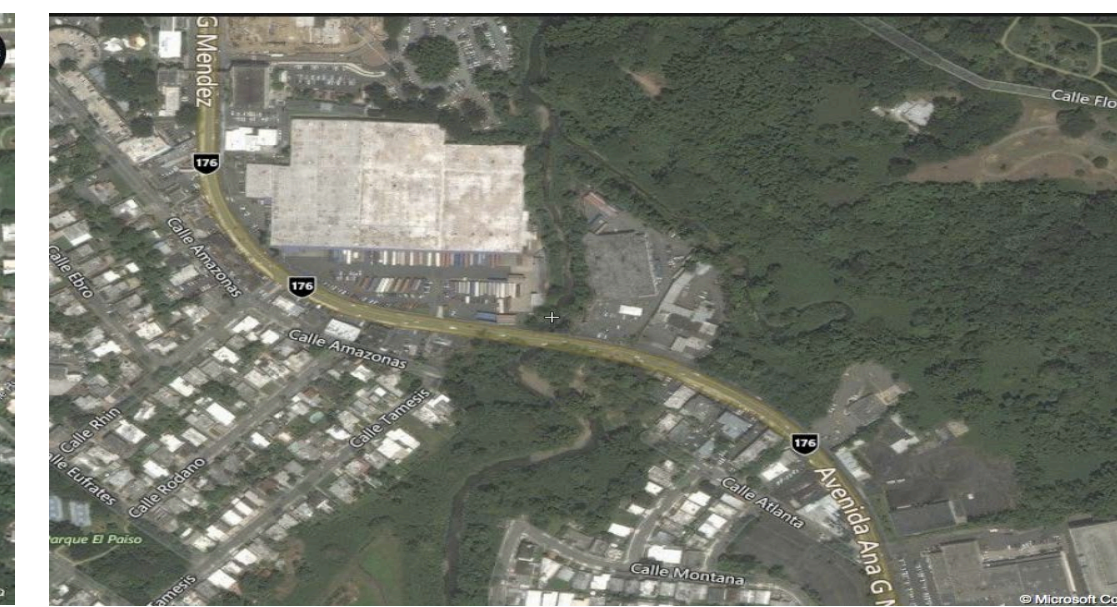


Figure C: Señorial Stream 2010

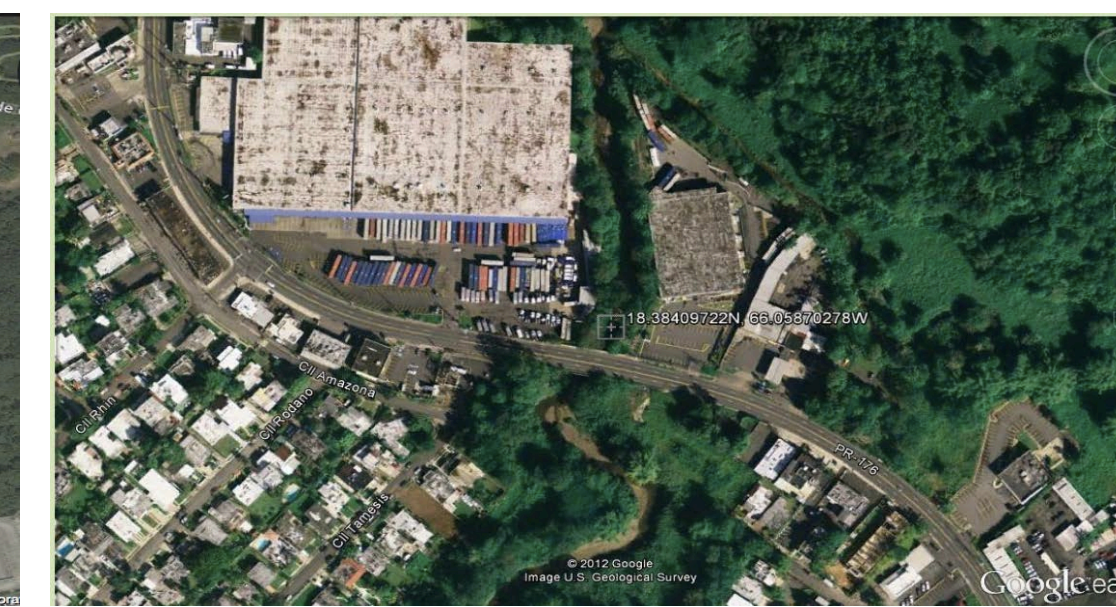
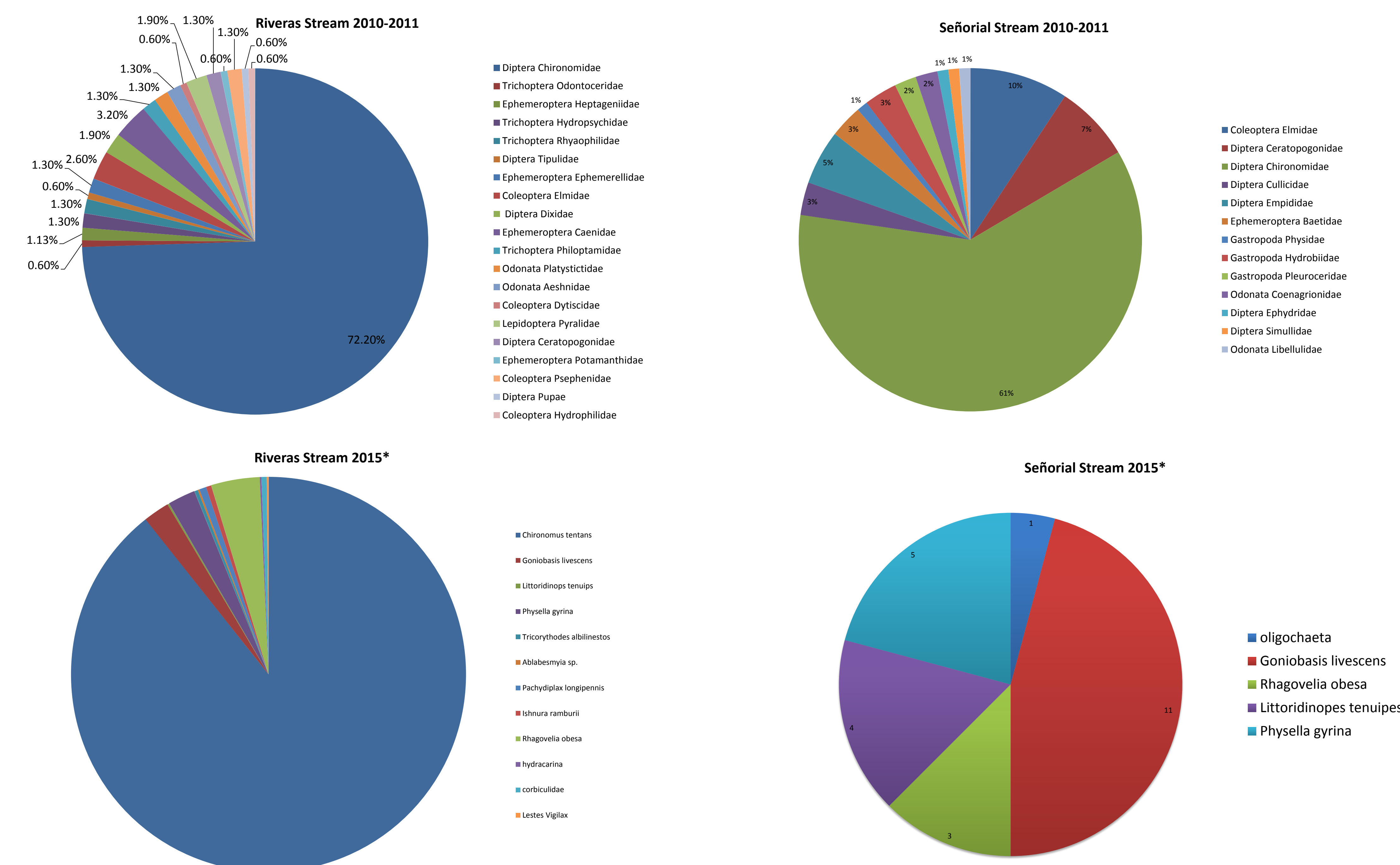


Figure D: Señorial Stream 2015

The first day of sampling a general description of the site, a physical characterization, water quality assessment, a visual assessment of the habitat and quantitative measurements of physical parameters were taken. In addition, samples of Total Suspended Solids (TSS), Total Phosphorus (TP), pH levels and air and water temperatures were taken. Water quality samples were done by filling three replicates of Total Phosphorus (TP), and three replicates of Total Suspended Solids (TSS). Additionally, air and water temperatures along with pH levels were measured with a Milwaukee® pH52 pH/ temperature meter.

Macroinvertebrate samples were taken the first sampling day at four different riffles of each stream. The samples were done moving upwards starting downstream, followed by a disturbance of each riffle for a period of sixty seconds while holding a kick net in front to capture all organisms that detached when the rocks were disturbed. The samples were then preserved in Whirl-pak® bags with 95% ethanol. Macroinvertebrates samples were counted and classified using the "Guide to Aquatic Invertebrates of the Upper Midwest". Water samples were sent in refrigerated containers to be analyzed at the Saint Michael's College and Johnson State College Water Quality Laboratories. All the obtained data was organized using averages to compare the results obtained through the 2010, 2011, 2012 and 2015 -year research period.

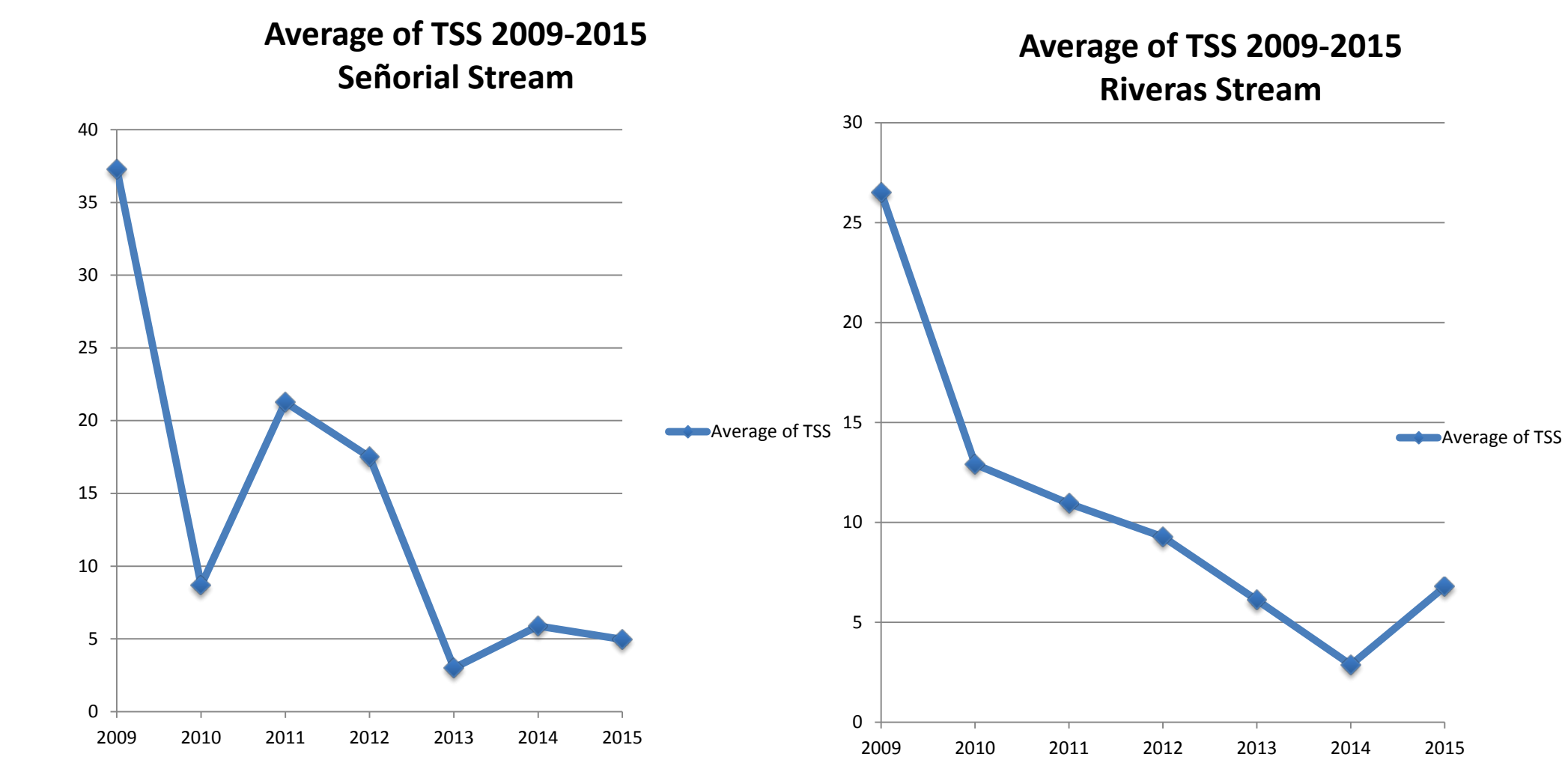
## MACROINVERTEBRATE RESULTS



Graph 1-4: Comparison of macroinvertebrates in both streams during the 2010-2011 and 2015 sampling seasons.

\* An average was not able to be calculated due to the scarce amount and variety of macroinvertebrates found, the total numbers of each species were graphed.

## WATER QUALITY RESULTS



Graph 5-6: Comparison of average TSS of both streams between 2009-2015

Year	PN_RivStrm_154		PN_SenStrm_49	
	Water Temp.	Air Temp.	Water Temp.	Air Temp.
2010	23.53	25.7	25.98	25.86
2011	24.42	26.6	27.46	27.71
2012	25.62	29.075	22.46	29.82
2015	27.4	25.28	22.64	25.72

Table 1: Comparison of average air temperature (oC) and water of both streams between 2010-2011, 2011-2012 and 2015.

## DISCUSSION AND CONCLUSION

The results obtained through the analysis of the streams support the hypothesis that the 2015 samples would be more contaminated than those of 2010-2012. The TSS difference between both years of sampling increased in Riveras Stream, while in Señorial Stream they decreased. These results in TSS may be due to the fact that near both streams, there were construction projects and there was an intense drought in 2015. In both streams, Riveras Stream and Señorial Stream, the amount of macroinvertebrates, compared to studies made in previous years, decreased greatly. In Señorial Stream there were barely any macroinvertebrates found after various attempts of collecting samples. It is believed that the months-long drought that occurred in 2015 played a huge role in the amount of macroinvertebrates that inhabited the streams, since in comparison to previous studies, there is a noticeable decrease in amount and variety of macroinvertebrates found.

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