Maracuto Stream: Effects of Hurricane Irene on the Rio Grande de Loíza Watershed

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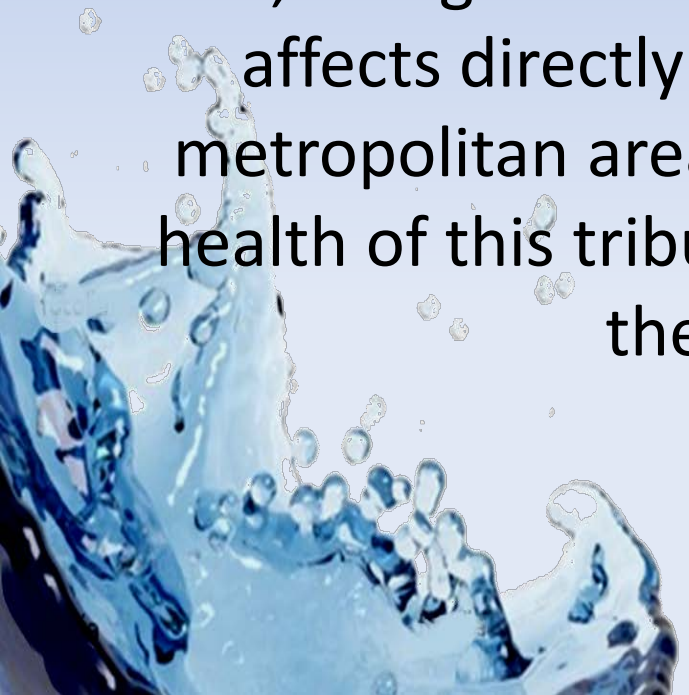
Introduction

Water is one of the world's most important natural resource. Conserving fresh water sources is one of humanities greatest challenges. This investigation is directed to monitor the health of the Maracuto Stream. This, being one of the Rio Grande de Loiza tributaries, affects directly the main source of Puerto Rico's metropolitan area's water supply. By monitoring the health of this tributary, we can measure its effects on the bigger river system.

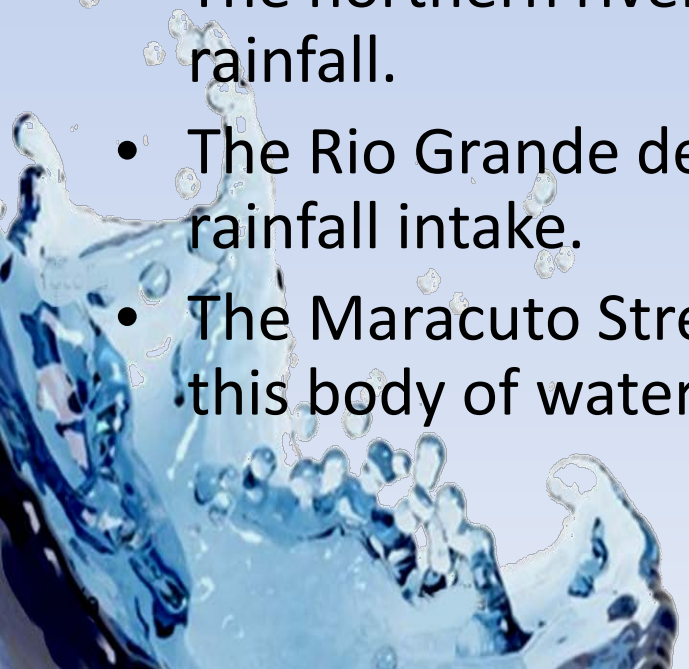


- Hurricane Irene caused downpours on the region, flooding most of the rivers and the Rio Grande de Loiza itself in the month of August.

- The main objective of this work is to find the changes that Hurricane Irene made on the stream by measuring the benthic-macroinvertebrates and water quality and by comparison with the past year.

Background Information:

- On August 22, 2011, Hurricane Irene passed over Puerto Rico. It entered through Humacao.
- It rose through the center of the island and left more than 20 inches of rain on Puerto Rico over its time on the island.
- The northern rivers of the island received the most rainfall.
- The Rio Grande de Loiza watershed received a huge rainfall intake.
- The Maracuto Stream is one of the main tributaries to this body of water.

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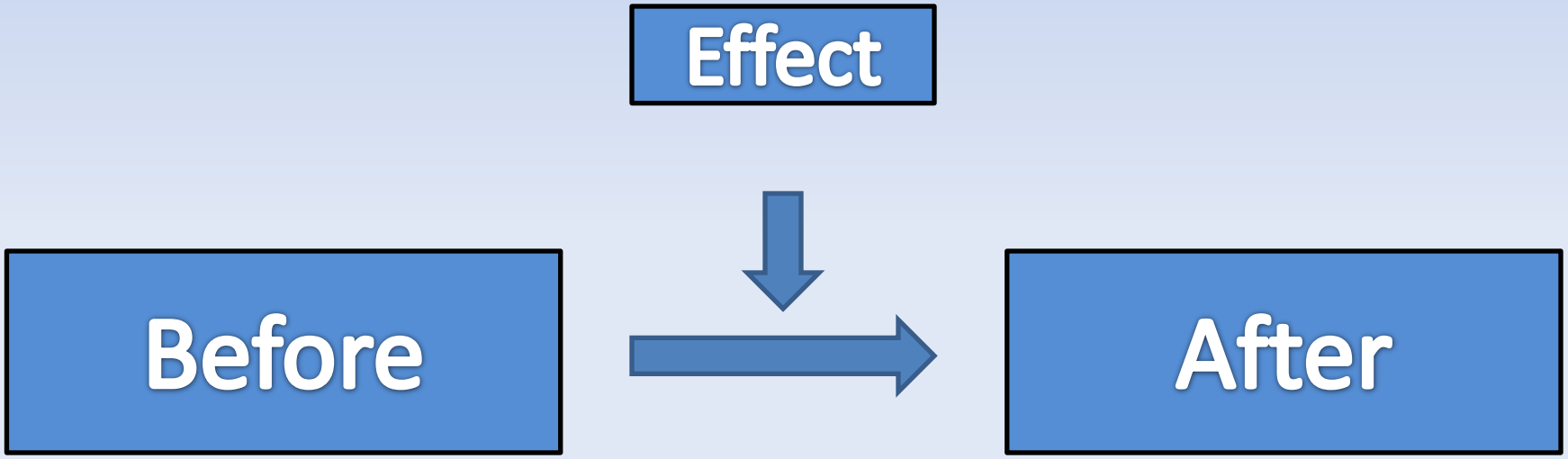
Hypothesis

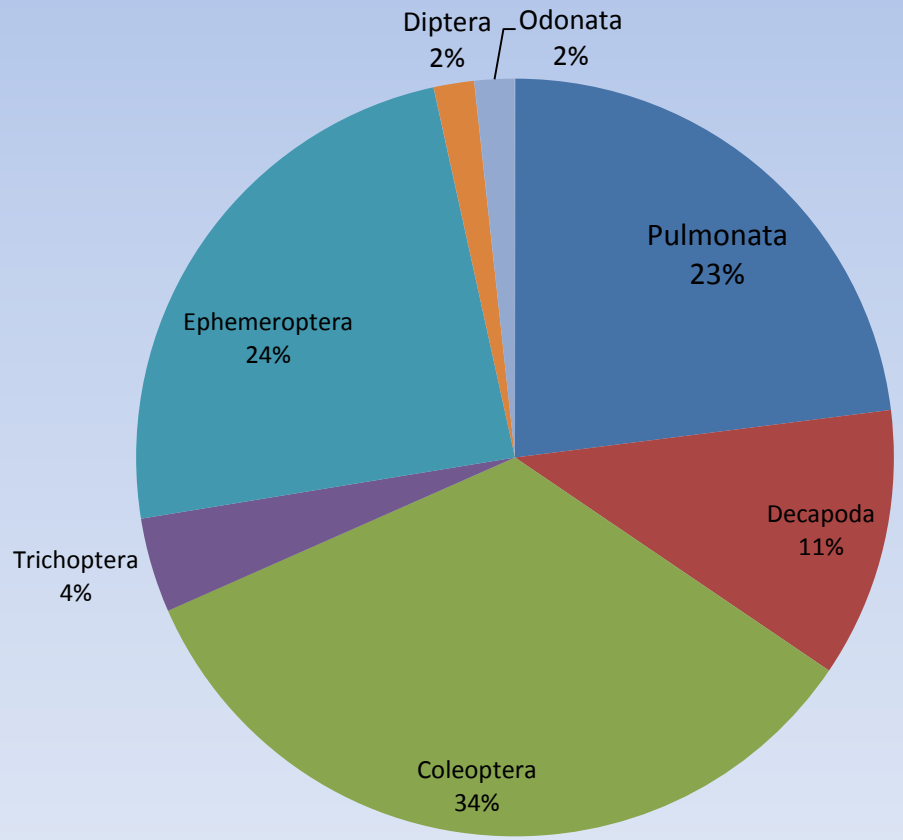
Hurricane Irene, as it passed over Puerto Rico, deposited a large quantity of rain over the area. If the stream sites are compared before and after hurricane Irene, then we will be able to measure its effects on the water quality of the stream and that these effects will have a positive impact on the stream sites.



Procedure

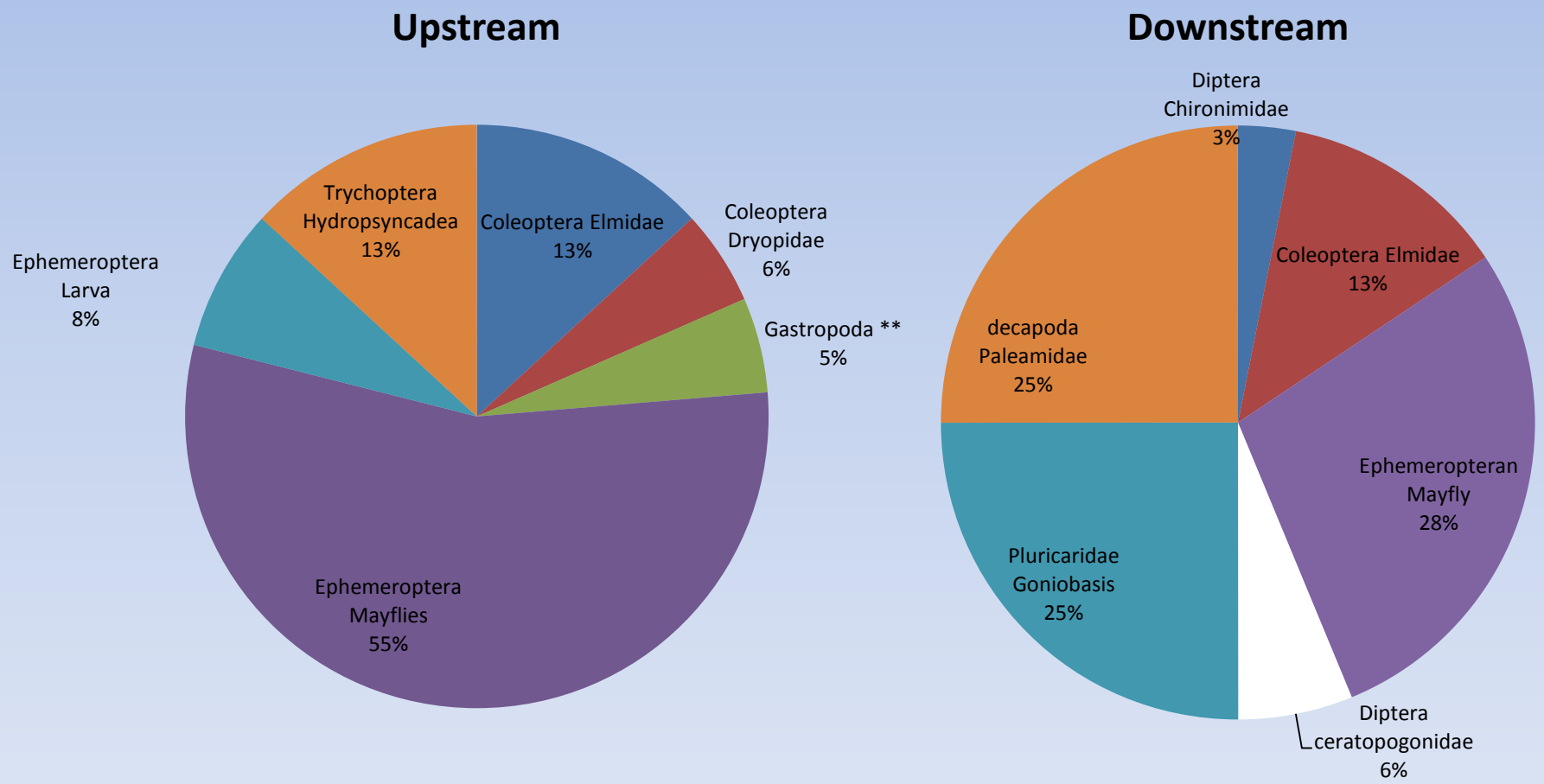
- **Utilizing the High School Team Guide from the Vermont Streams Project, all procedures regarding stream site assessment, water quality procedures and macro invertebrate samples were followed.**
- **Macro Invertebrate samples were taken 1-2 months after Hurricane Irene.**
- **4 replicates(2 upstream, 2 downstream) where collected via hand-scrub method(view-High School Team Guide)**
- **Samples were collected at the site; they were cleaned of large debris and were put in 100% ethyl alcohol for specimen conservation.**
- **Sample were taken to the school where they were separate from the inorganic substances and the Macro-Invertebrates were classified under microscope**
- **Using, EPT (Ephemerotpera, Plecoptera & Trichoptera), which is a number indicator to water quality and Hilsenhof's Biotic Tolerance Index, samples were analyzed.**
- **Utilizing the later, samples were graphed and conclusions were drawn.**

2010-2011
Total Macro Invertebrates



Order	Family	Count	Tolerance Values	TV x C
Pulmonata	Pleurocaridae	24	8	192
Decapoda	Palaemoidae	3	6	18
Coleoptera	Hydrobiomorpha	22	5	110
Coleoptera	Dryopidae	3	5	15
Trichoptera	Philopotamidae	2	3	6
Coleoptera	Elmidae	1	4	4
Coleoptera	Elmidae	10	4	40
Ephemeroptera	mayfly	23	3	69
Ephemeroptera	mayfly	3	3	9
Diptera	Chironomidae	1	7	7
Decapoda	Palaemoidae	17	6	102
Pulmonata	Lymnaeidae	16	8	128
Coleoptera	Elmidae	7	4	28
Ephemeroptera	mayfly	16	3	48
Odonata	Protoneuridae	2	5	10
Diptera	Ceratopogonidae	1	6	6
Coleoptera	Chrysomelidae	5	5	25
Coleoptera	Dryopidae	4	5	20
Trichoptera	Hydropsychidae	2	5	10
Trichoptera	Philopotamidae	1	3	3
	Total	175		850

2011-2012
Macro Invertebrate Count



Order	Family	Count	Tolerance Values	TVx C
Diptera	Chironimidae	1	7	7
Coleoptera	Elmidae	4	4	16
Ephemeropteran	Mayfly	9	3	27
Diptera	ceratopogonidae	2	6	12
Pluricaridae	Goniobasis	8	6	48
decapoda	Paleamidae	8	6	48
Coleoptera	Elmidae	5	4	20
Coleoptera	Dryopidae	2	5	10
Gastropoda	**	2	6	14
Ephemeroptera	Mayflies	21	3	63
Ephemeroptera	Larva	3	3	9
Trychoptera	Hydropsyncadea	5	5	25
Total		70		299

Hilsenhoff Biotic Index

Biotic Index	Water Quality	Degree of Organic Pollution
0.00-3.50	Excellent	No apparent organic pollution
3.51-4.50	Very good	Possible slight organic pollution
4.51-5.50	Good	Some organic pollution
5.51-6.50	Fair	Fairly significant organic pollution
6.51-7.50	Fairly poor	Significant organic pollution
7.51-8.50	Poor	Very significant organic pollution
8.51-10.00	Very poor	Severe organic pollution

$$FBI = \frac{\sum x_i t_i}{n}$$

where

x_i = number of individuals within a taxon

t_i = tolerance value of a taxon

n = total number of organisms in the sample

Hilsenfoff Biotic Index 2010-2011

The Taxa collected from last year's monitoring had the following results:

$$FBI = \frac{\sum x_i t_i}{n}$$

Biotic Index Downstream

5.08

Biotic Index Upstream

4.6

Biotic Index Total

4.85

Hilsenfoff Biotic Index 2011-2012

The Taxa collected from this year's monitoring had the following results:

$$FBI = \frac{\sum x_i t_i}{n}$$

Biotic Index Downstream

4.93

Biotic Index Upstream

3.71

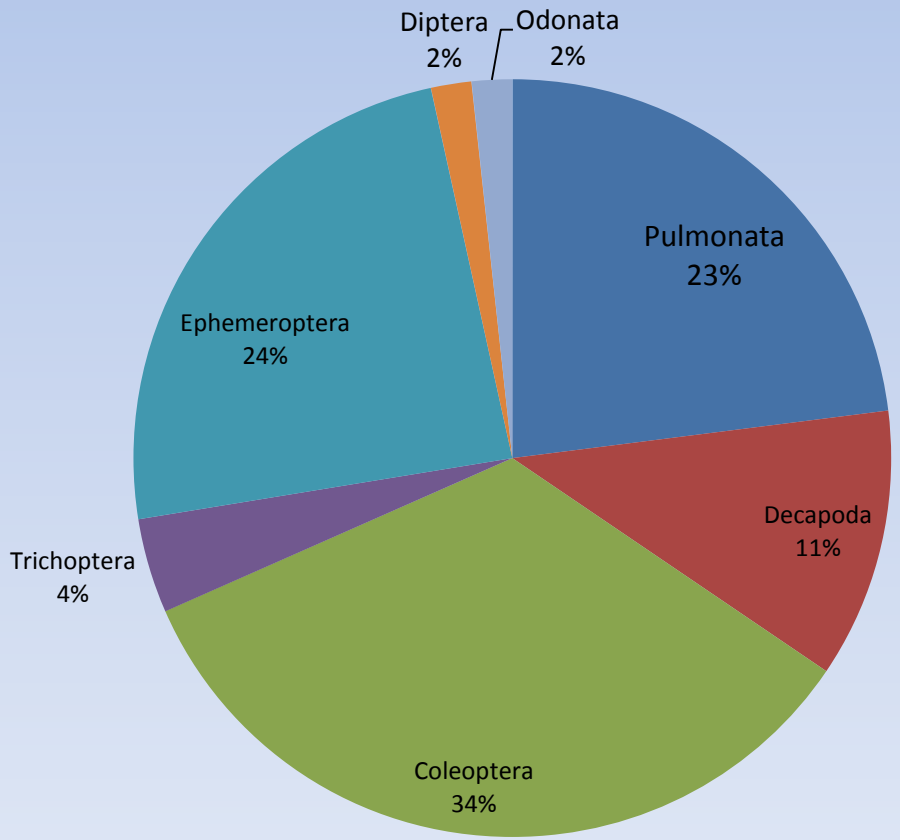
Biotic Index Total

4.27

EPT Count

2010-2011
EPT Count

The Taxa collected from last year's monitoring had the following results:



EPT% Downstream

31%

EPT% Upstream

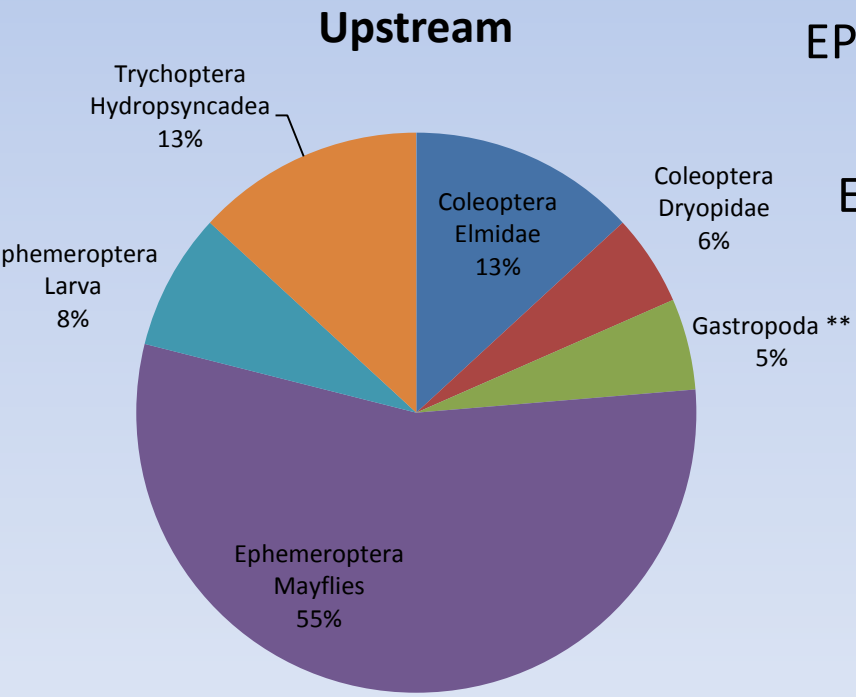
31%

EPT% Total

6%

2011-2012
EPT Count

The Taxa collected from this year's monitoring had the following results:



EPT% Downstream

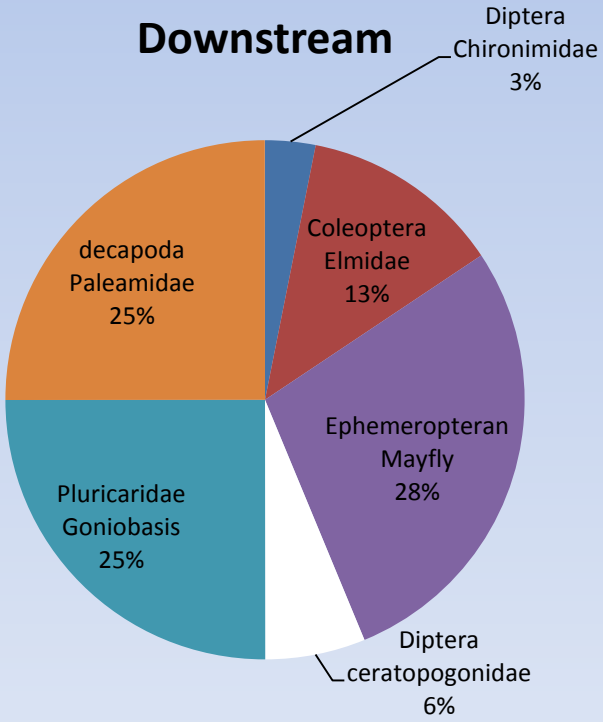
28.12%

EPT% Upstream

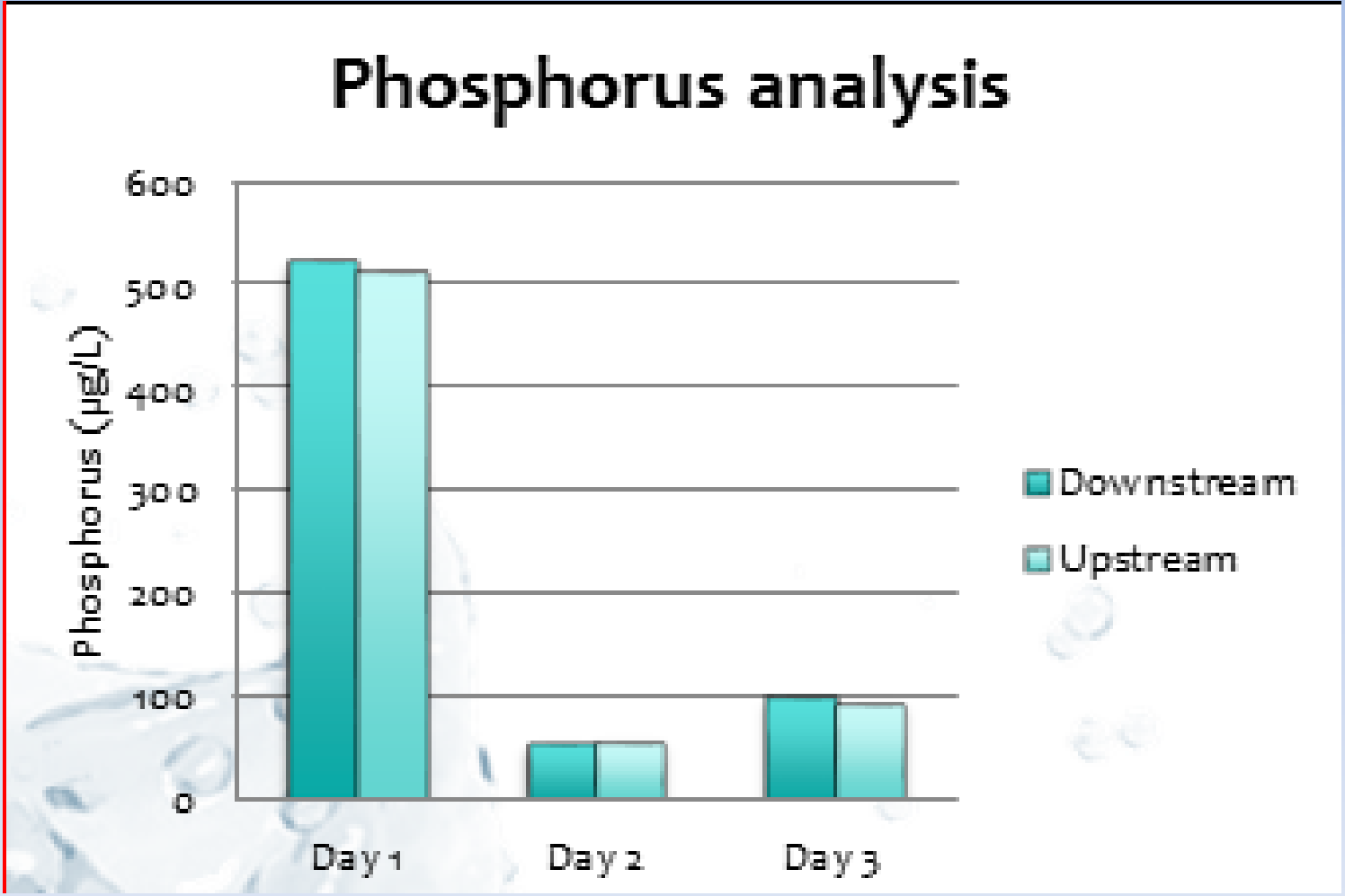
76.3%

EPT% Total

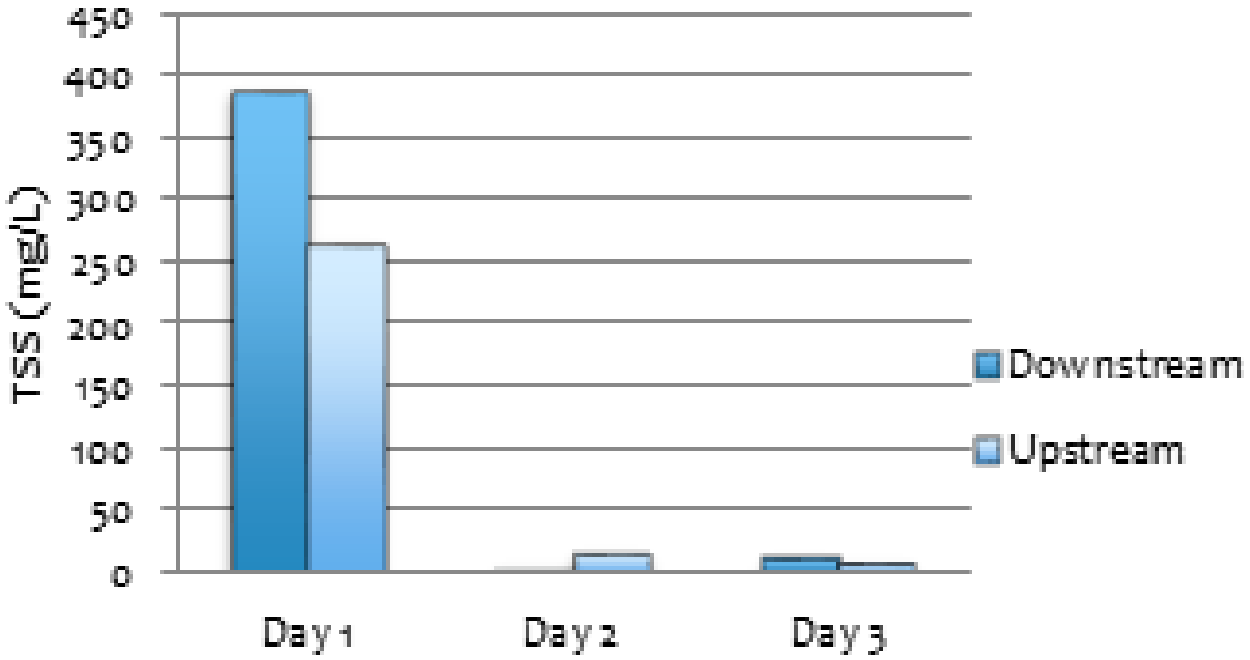
54.2%

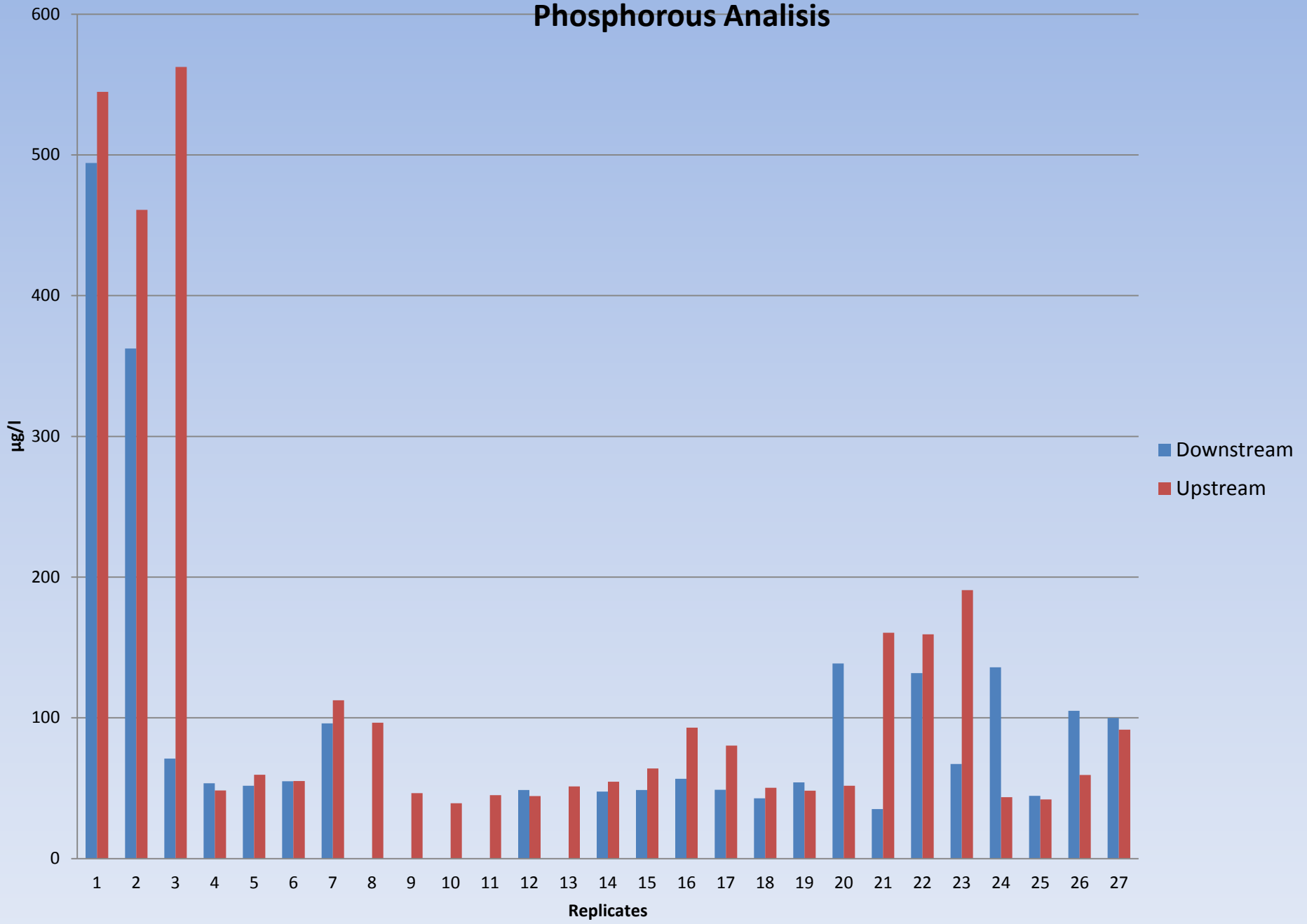


Water Quality

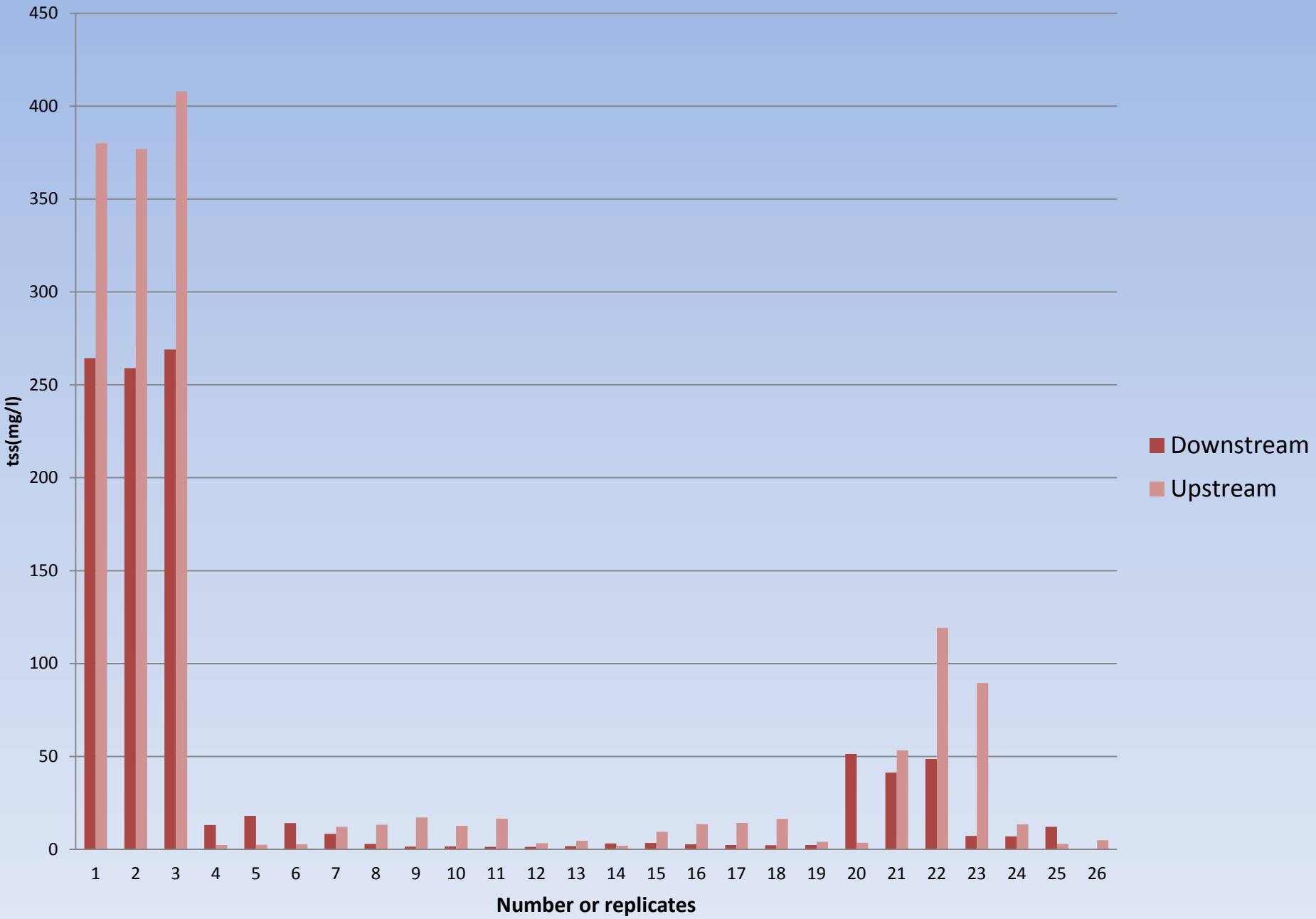


Total suspended solids analysis




Phosphorous Analisis
600
500
400
300
200
100
0
µg/l
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
Replicates
Downstream
Upstream

Total Suspended Solids



Conclusion

By comparing last year's results with this year's results, we found that the Macro-Invertebrate count was low. This could be attributed to the exponential downpour of the hurricane, wiping out the population of insects. The population that grew anew is directly correlated with the amount of pollution and organic debris in the stream. We found a decrease in the FBI which means the floods washed away all organic pollutants that were affecting the area thus reducing its effects on the water quality.

Conclusion

- Moreover the amount of EPT's increased drastically, meaning that the health of the stream increased. The hypothesis was proven to be correct as the analysis indicates that the atmospheric event had a positive output on the streams. Although most of the downstream area was affected and its physical aspects changed, in terms of the water quality, its healthier than last years. The rains washed and cleaned the water in this river and this shows that Hurricanes are a destructive force of nature that helps the rivers revert back to their natural, pristine order.

Future Work

- Hurricane Irene affected various parts of northern America, including Vermont. Site data can be collected and compared from these sites and they can be compared to past years .
- E-Coli samples could also be taken and analyzed.
- All the pollutants that were washed away, were dumped into the Rio Grande de Loiza, and this would affect greatly its stream health and the estuary in which this discharges.
- Studies can be conducted as to how the discharges of many tributaries affect the main river system in time of floods.

Questions???

References:

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