The influence of water environmental factors on mosquito larvae

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Abstract

The study investigated the relationship between environmental factors and mosquito larvae. We measured the dissolved oxygen, electrical conductivity, water temperature, pH value and the number of mosquito larvae at our school which in Northern Taiwan. The measurement locations are the ditch in front of the school gate, the central garden, the health services center and the fountain. Only the ditch in front of the school gate and the central garden have mosquito larvae. After catching the larvae, we use GLOBE Observer: Mosquito Habitat Mapper App to identify whether it is a vector mosquito. Our results showed that the environment factors and mosquito larvae's connection. there are more larvae with neutral pH, high electrical conductivity and they can tolerate the low dissolved oxygen environment. There's no mosquito larva in the fountain, maybe because there're fish and tadpoles inside. Total coliform bacteria exceeded in our school ditches.

Keywords: E. coli., mosquito larvae, water environmental factors.

Research question

1.Are there any larvae in those ditches at the school?
2.What are the effects of environmental factors and larvae in the water ditch?
3.Are there any associations between the number of E. coli and larvae?

Introduction

Dengue fever is spread through the bite of *Aedes* mosquitoes (Preechaporn et al., 2006). They can transmit the virus while biting a healthy person. Dengue fever is caused by dengue viruses infection which a kind of mosquito-borne viral disease in

tropical and subtropical regions of the world (Guzman MG et al., 2010). Taiwan is an island country located on the Tropic of cancer in East Asia. During summer, dengue fever spreads frequently. Government will publicize how to avoid dengue fever. But not every stagnant water can be cleaned, such as ditches and streams. This figure tells about the number of confirmed cases in every month from 2017 to 2020 (Figure 1). The confirmed cases are concentrated from July to October which is the rainy season in Taiwan (Figure 2). Except the epidemic early in 2019. We speculated that the temperature in April 2019 in southern Taiwan was the highest in the past thirty years, which prematurely caused the outbreak of the epidemic. (Taiwan Centers for Disease Control).

Last year, we found larvae in some ditches inside and outside of our school. In recent years, dengue has happened near the school which has led some people die. We consider the relationship between environment factors and the number of mosquito lava. Because the river outside our school is too deep to get the water sample. We chose some ditches inside our school. Every time we walk through these ditches, it always has a stinky smell with mosquitoes coming out of it. All of us are afraid of the dengue fever outbreak, so we want to know what kind of mosquitoes it is and what kind of water bodies are the most suitable for larvae to grow up.

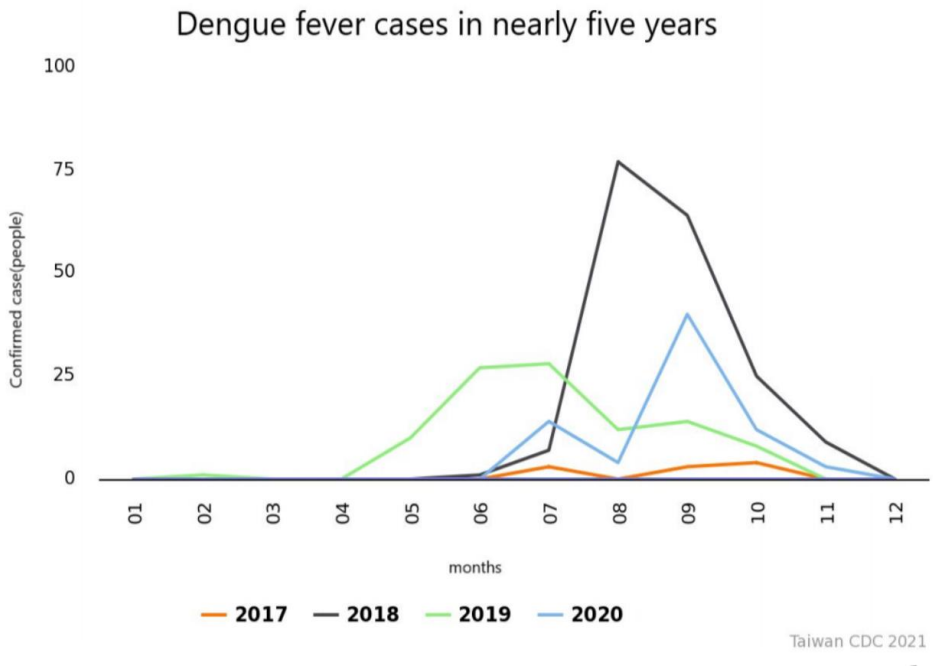

Figure 1. Dengue fever confirmed cases in Taiwan in nearly five years.

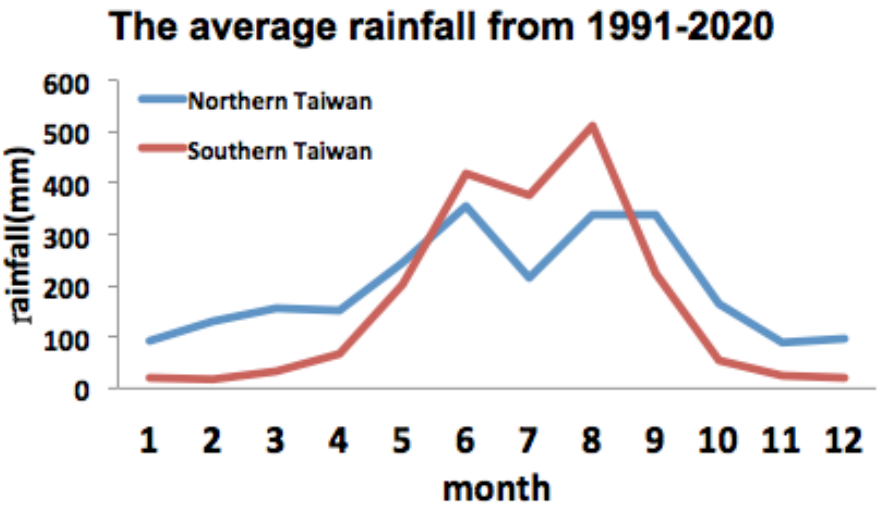

Figure 2. The average rainfall in Taiwan from 1991 to 2020.

Materials and methods

1. Study sites

The study was conducted on Danfeng High School, North Taiwan (25°01′16″N 121°25′00″E). (Figure 3)

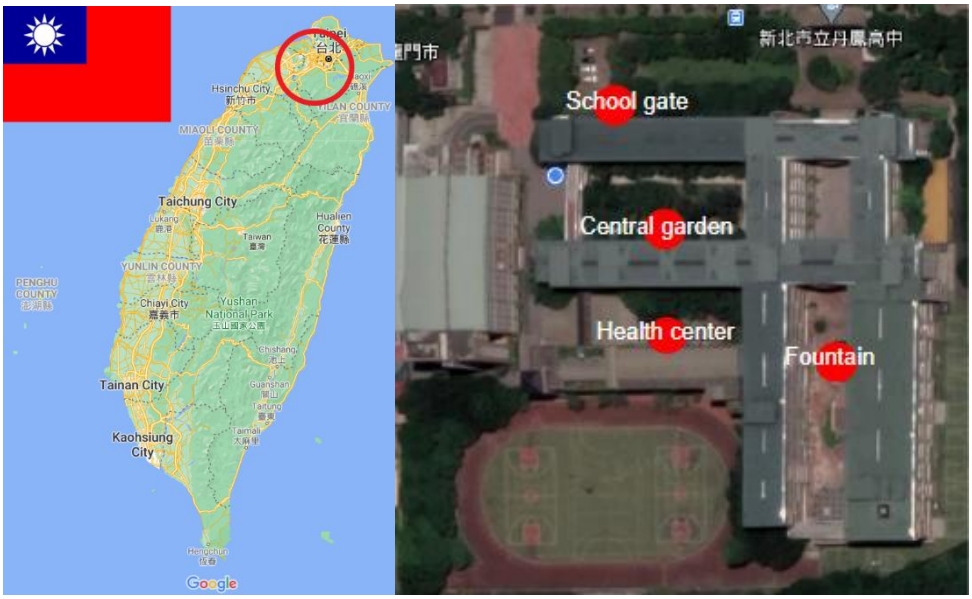

Figure 3. The picture at left is Taiwanese map. The flag upon Taiwan is our flag. And the red circle is Danfeng high school's location. The picture at right is Danfeng high school's satellite image. Those red spots are positions we measure.

2.Data Collection

Mosquito larva survey was conducted in Danfeng High School in Taiwan in April to October, 2020. We studied four sites : central garden, school gate, fountain, health center (Figure 4).

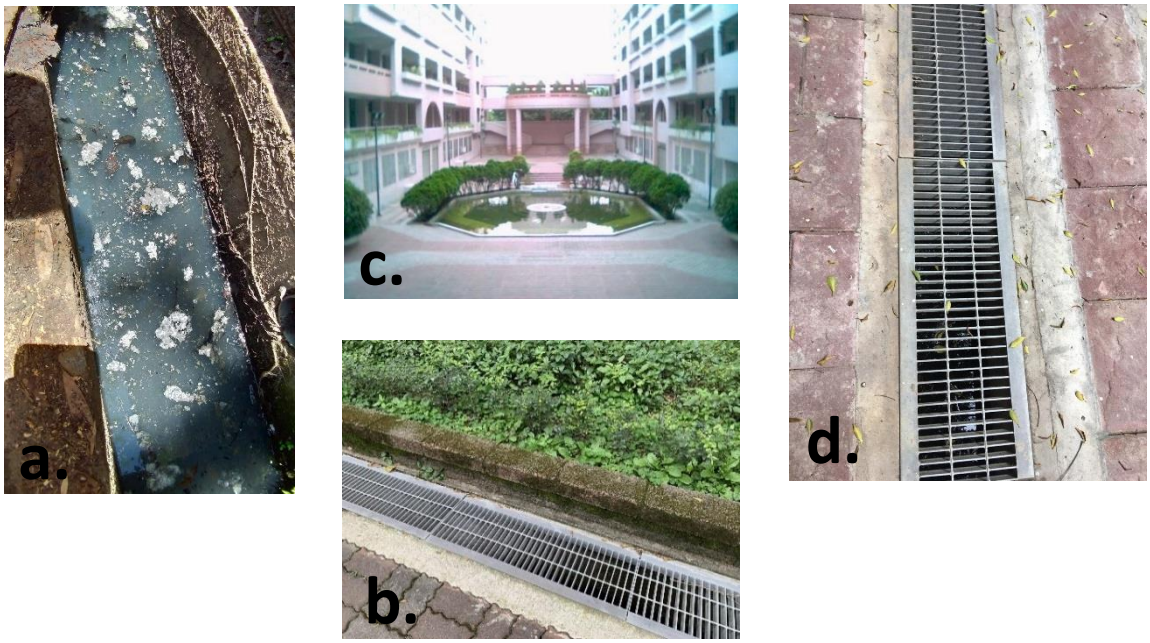

Figure 4. Those pictures are experiment sites that we measure.
(a) the ditch of central garden (b) the ditch in front of school gate (c) fountain (d)health center

3.Study design

Experiment 1

We Collected mosquito larvae two times in April and May. We input data with Mosquito Habitat Mapper App. We investigated the color, smell of the four different water bodies. Whether there are mosquito nearby, and whether there are larvae in it.

Experiment 2

We chose three locations except the health center. Because the ditch of the health center was under construction from July to September, so it cannot be measured. In

order to know the difference in the number of larvae in each ditch more accurately, we used a net to sweep the surface of the water. Take three samples. Wait three minutes between each sample. We also measured the dissolved oxygen, electrical conductivity, water temperature and pH value. (Figure 5)

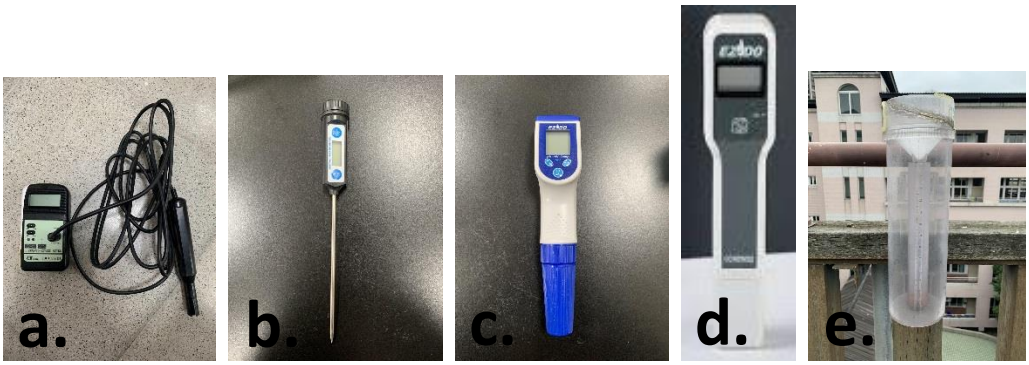

Figure 5. Those pictures are our tools used for measure the environmental factors. (a) test dissolved oxygen (b) test water temperature (c) test water pH value (d) test water electrical conductivity (d) test rainfall

Experiment 3

Because mosquito larvae feed on organic detritus from the environment, particularly bacteria, algae. So, we want to know the amount of bacteria in ditch water. Measure the number of bacteria and E. coli in the water in September and October respectively, for the bacterial count part, we dilute three ditch water 1000 times with deionized water in a sterile environment, drop 200um diluent on the solid medium, and place it in a constant temperature incubator for one day after sealing.

We use the E.coli Count Plate to measure the number of E. coli. All three ditch samples were collected on the same day on October 15th, water samples performed by using serial dilutions in sterile buffered water, followed by E. coli/Coliform Count Plate in replicates of two. (Figure 6)

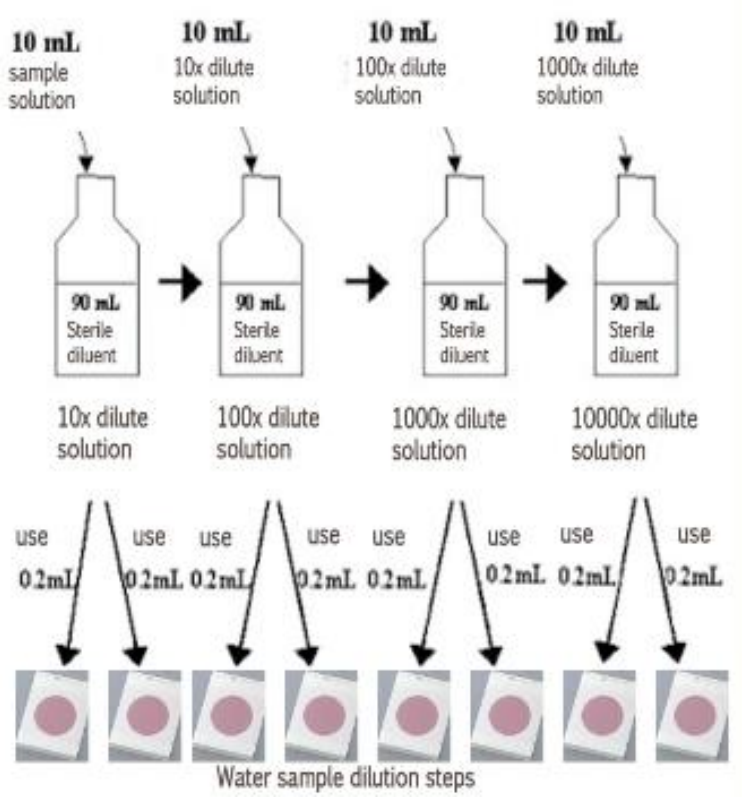

Figure 6. This figure explain our dilution method and how to detect E. coli.

Result

Experiment 1

We cannot find any larva in the ditch of the health center and fountain. But there are lots of mosquito larvae in the school gate and central garden. We think it's because there are tadpoles and fish in the fountain and it's also the brightest among those locations (Table 1-2).

Table 1. Ditches in different environment factor and whether there have any mosquito larvae in it or not on Apr 29th .

date	location	number of larvae	mosquitoes	water color	water smell	other creatures
4/29	ditch beside the school gate	>200	yes	yellow	ditch smell	leech
	health center	0	yes	white	ditch smell	spiders
	fountain	0	yes	clear	no smell	water strider, fish, tadpole
	central garden	>100	yes	like soapy water	poo poo smell	snails, dead mosquitoes

date	location	number of larvae	mosquitoes	water color	water smell	other creatures
5/6	ditch beside the school gate	40	yes	yellow	stinky smell	no other creatures
	health center	0	yes	turbid	stinky smell	no other creatures
	fountain	0	no	clear	no smell	no other creatures
	central garden	>50	yes	like soapy water	stinky smell	screw

Table 2. Ditches in different environment factors and whether there have any mosquito larvae in it or not on May 6th .

Experiment 2

We can know the number of mosquito larvae in the ditch in front of school gate is the most. (Figure 7)

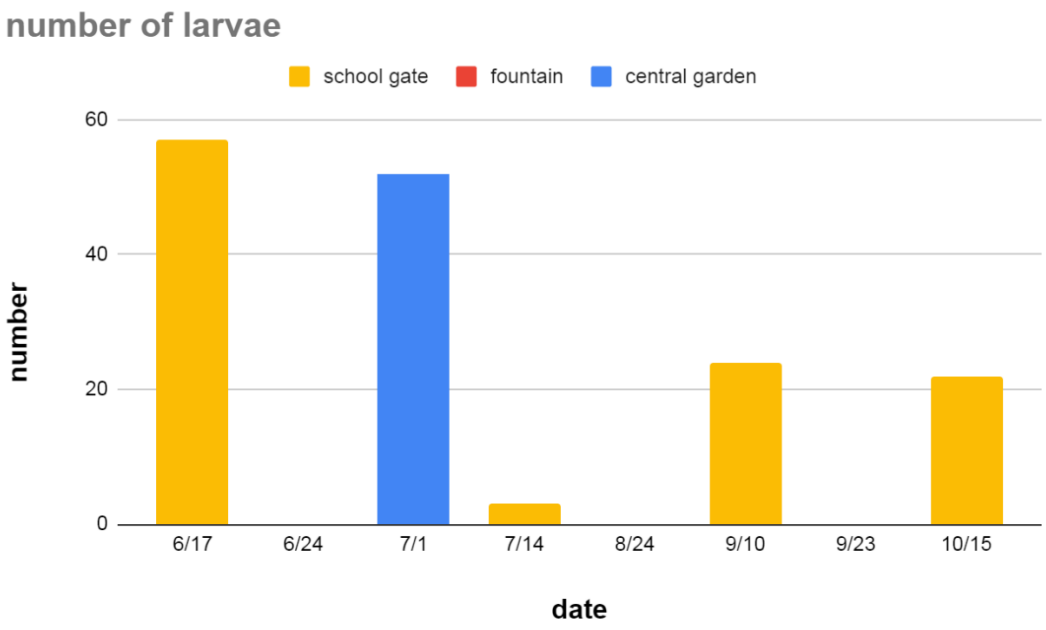

Figure 7. The number of mosquito larvae in three ditches

Water temperature

The water temperature in different locations has small differences. There are more larvae in over 30 degrees Celsius than under 30. (Figure 8)

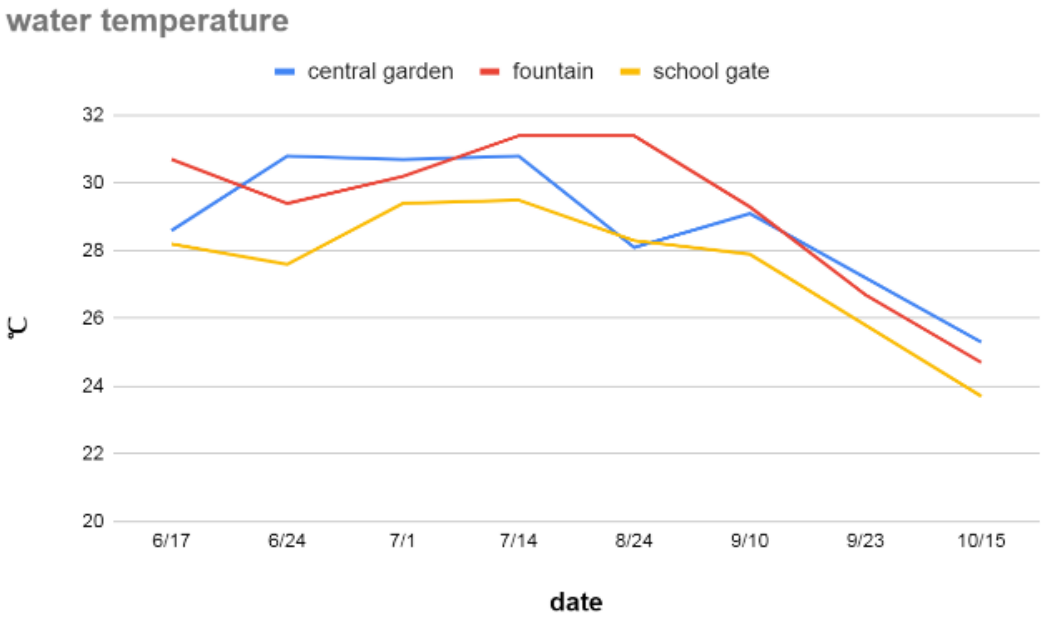

Figure 8. The water temperature in three ditches

Water conductivity

The electrical conductivity is high in both the school gate and central garden which means there is high pollution in both locations. And the conductivity goes down in July and August when students are on summer vacation. (Figure 9)

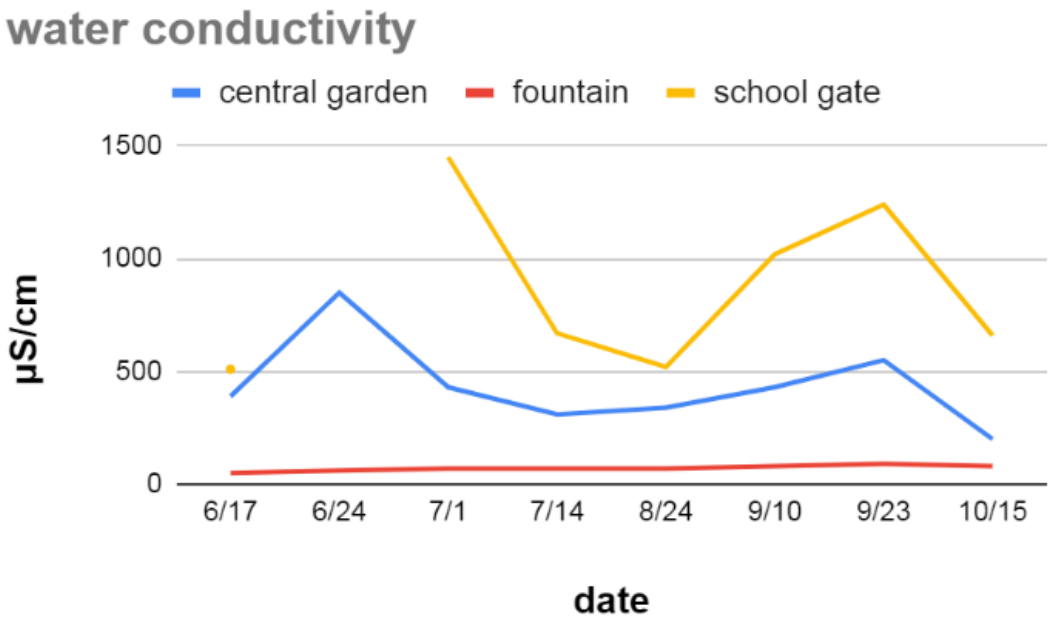

Figure 9. The water conductivity in three ditches

pH value

Only the ditch in front of school can catch mosquito larvae easily. There pH value always in 7 to 8, so we speculate that mosquito larvae suitable for middle pH value. No larva has ever been found in the fountain. The pH value of the fountain is higher than both the school gate and central garden. (Figure 10)

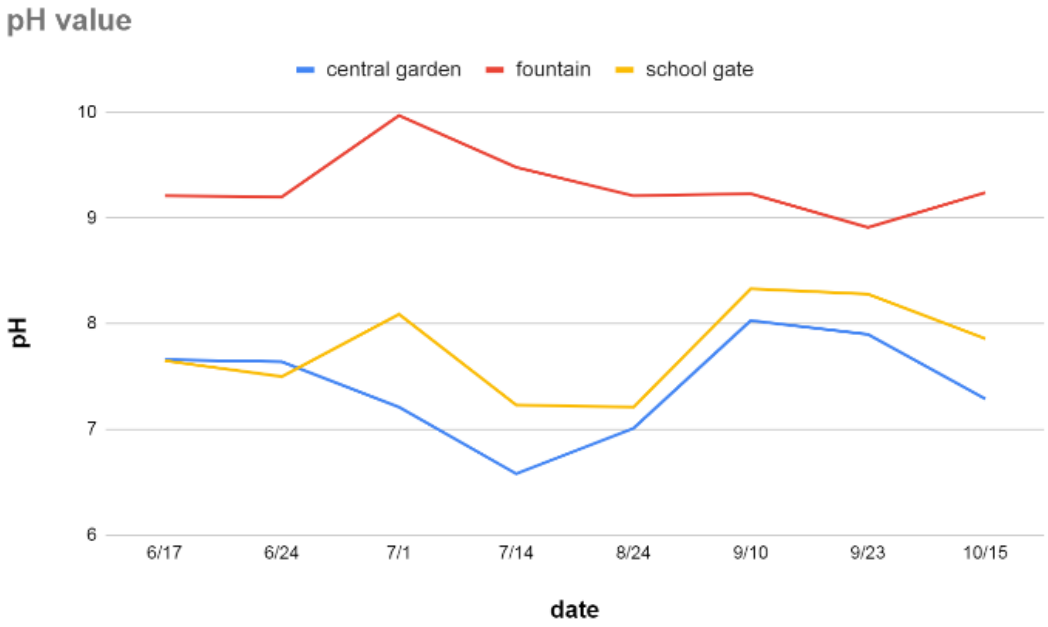

Figure 10. The pH value in each ditch in three ditches

Dissolved oxygen

The fountain has the highest amount of dissolved oxygen due to mechanical pumping and there are a lot of algae inside. On the other side, it also seems that mosquito larvae can survive in low dissolved oxygen. (Figure 11)

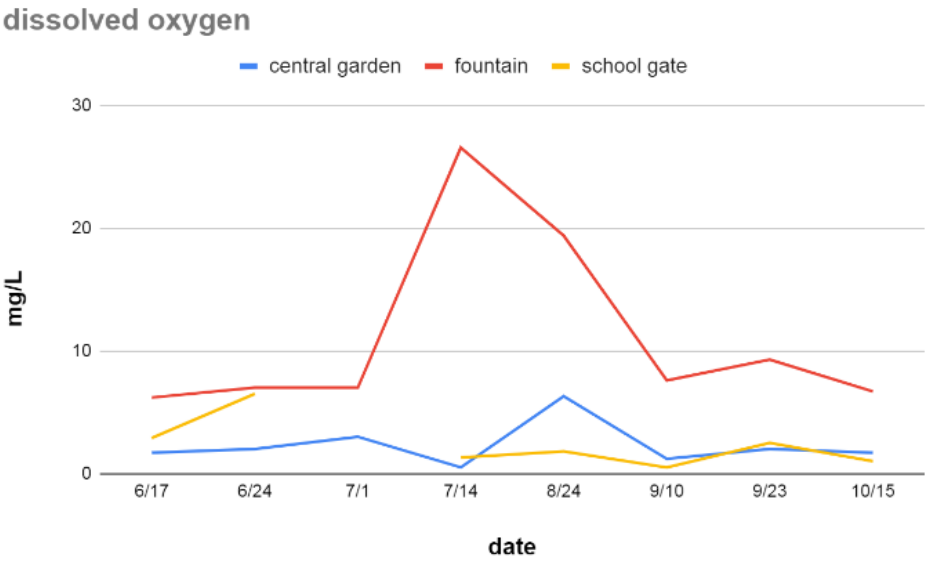

Figure 11. The dissolved oxygen in each ditch in three ditches.

Experiment 3

The number of E. coli is the highest in the central garden. The public sewer's E. coli standard is 2000~3000, which is the red line on the figure (Figure 12). So the central garden and the school gate are beyond the standard. The three pictures above are the original image. (Figure 12)

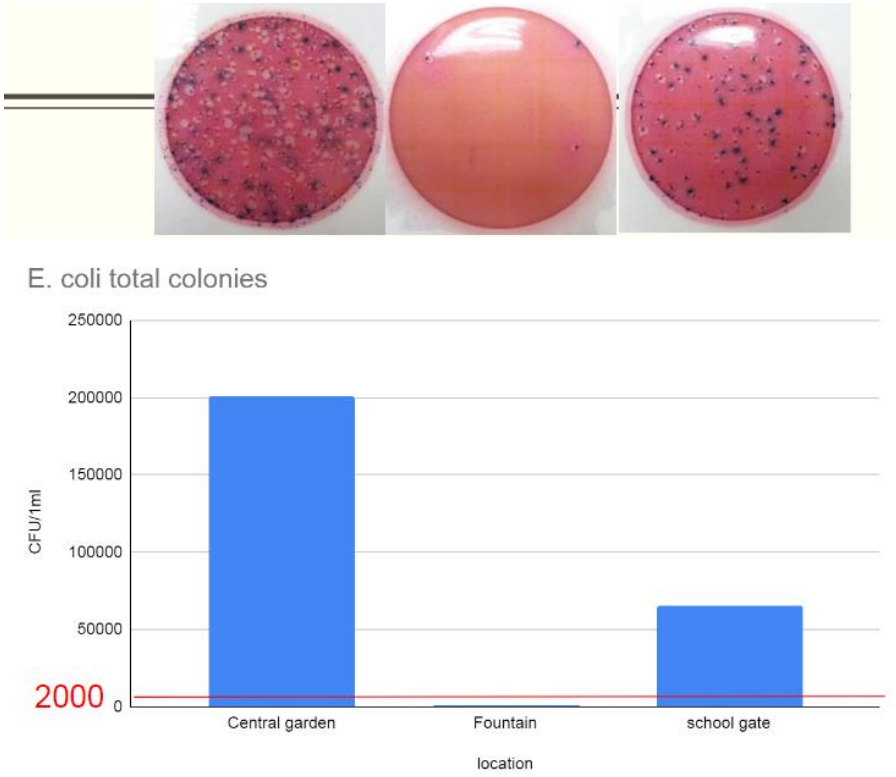

Figure 12. Top of three pictures are 3M Petrifilm Coliform and E. coli Count Plate. At the left, this water sample was came from the ditch of central garden. In the middle, this water sample was came from fountain. At the right, this water sample was came from the ditch in front of school gate. The bottom of this figure is the E. coli count and the number of larvae in school gate ditches. The E. coli total colonies in three ditches. And 2000(CFU/1ml) is the lowest standard in discharge. The three pictures above are the E. coli Count Plate original image.

Conclusion

1. There are mosquitoes in the school gate ditch and central garden ditch.
2. Comparison to three sites, it's hard to find the relationship between temperature and number of larvae. But it seems that there are more larvae with neutral pH, high electrical conductivity and they can tolerate the low dissolved oxygen environment.
3. There is no mosquito larvae in the fountain, maybe because there're fish and

tadpoles inside.

4. Total coliform bacteria exceeded in our school ditches.
5. If we can find the environment mosquito larvae not adapt and use other thing to change the quality of water. Then we can decrease vector mosquito breeding.
6. We can try to change the environmental factors in the future. Ex : change the pH value or electrical conductivity... etc. And observe mosquito larvae grow up situation.

Discussion

We found some study did the similar experiment. Their experiment is about mosquito larvae the most suitable pH value. Both species complete larval development in waters ranging from pH 4 to pH 11(Thomas M. Clark et al., 2004). According to this reference, the pH of fountain is pH 9 to 10 should have mosquito larvae. But in our experiment, there haven't any mosquito larvae. We speculate there is no mosquito larvae because also have other biological in the fountain like fish.

We think the experiment's result error may occur because the ditch was under construction in July to September in our school. The datum are unstable. So it is too difficult to find the continuous association.

Research outlook

We have found mosquito eggs and hatched them. And hope that we can raise them in three different pH to hatch them to prove our results. Or control the number of bacterial in the water sample, observe mosquito larvae fit to survive in what kind of water sample. In extreme clean water, extreme dirty water or between two of them.

Acknowledgements

We thank Mrs. Ting Fang Lin for helping with experiment design, data analysis and article revision. From the experiment design in the started, we discussion a lot of time and learn about a lot of things. In the experiment procedure, she taught us how to use instruments which in the lab to measure environmental factors; how to make a culture medium; how to dilute the water sample from ditch. Anyway, a lot of thing were learning from Mrs. Ting Fang Lin. Follow-up, she also participated in the discussion and gave some advice when we made charts and analyze data. She also helped us to modify this report when we wrote it. See if there are any mistakes in the English grammar, or where the content is less typing, if pictures are misplaced or placed... etc. Finally, we finished this research after repeated corrections by the teacher. She really helps us a lot.

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