The study of physical factors affecting habitats suitability for increasing growth of mussels

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Abstract

First, I set the study area around the Gulf of Thailand. All mussels that were collected belong to the species *Perna Viridis*. I found that the mussels in S3 area have the highest growth. From the study of biological factors, I found that the increase in number of barnacles decreases the growth of mussels. From the study of physical factors, I found that the growth of mussels increases with water flowrate. After that I studied the relationship between biological and physical factors and found that flowrate is inversely proportional to the number of barnacles and directly proportional to dissolved oxygen, both with statistical significance. I found that in every 7 square meters area, there are total number of 14 mussel poles, which I defined as Formation A. I found that mussel poles are affecting the flowrate. Therefore, I would like to create appropriate habitats for mussels by applying 3 new formation of mussel poles defined as Formation B, C, and D. I then tested them to see how it will affect the flowrate and found that Formation D makes water flow the fastest. When I increased the length into 3 farms, it still makes the water flow the fastest. After testing in laboratory, I tested these 4 formations in the real farm. I found that, in the real farm, formation D makes water flow the fastest and the growth of mussels is also the best. Calculation of the revenue revealed that it can make 6,280.66 USD.

In conclusion, an appropriate way of formatting the habitat of mussels will beneficially affect the flowrate and resulting in increase of mussel productivity. With Formation D that I had created, the productivity of mussel can be increased by 28 percent compared to the original way.

Research Question

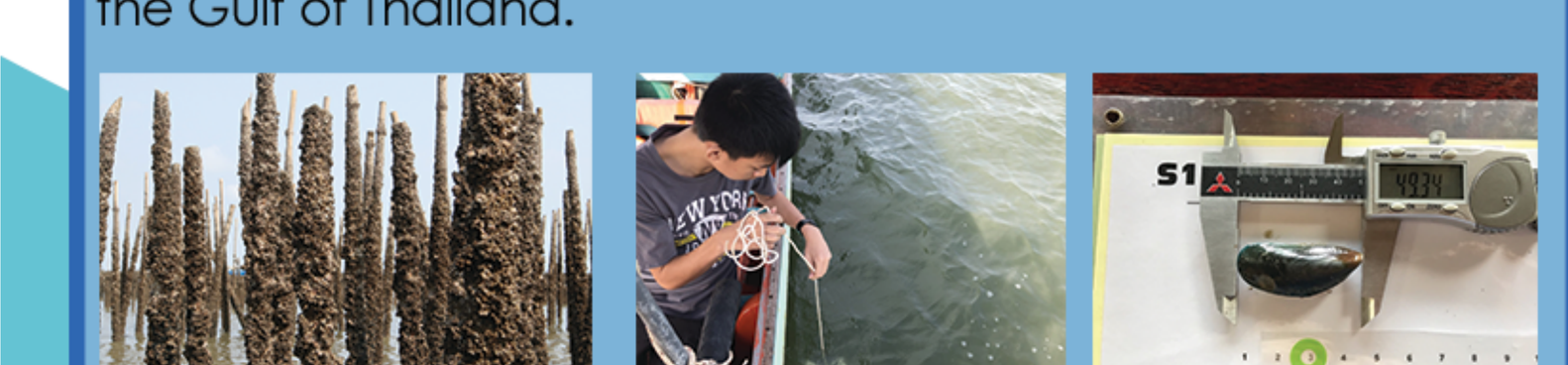
1. Can suitable habitat of mussel increase the growth and productivity of mussel?
2. Which physical factors affects the suitability of mussel habitat?

Introduction

"Mussels" is a species of cockles in the Phylum: Mollusca, Class: Bivalvia. It has a common name called Green Mussel. There are 3 species of mussels: *Perna viridis, Perna perna and Perna canaliculus* (Rajagopal, 2005). Mussel live by sticking along rocks in the coastal area. They are found spreading along the coasts of many countries. There are many methods of mussels farming. The most popular method is using the poles. This method is suitable for shallow depths of 4-6 meters in the mud or sand (Masen, 2017). Apart from the habitas factors, mussels farming must also consider about physical factors too. (Sirichai, 2009).

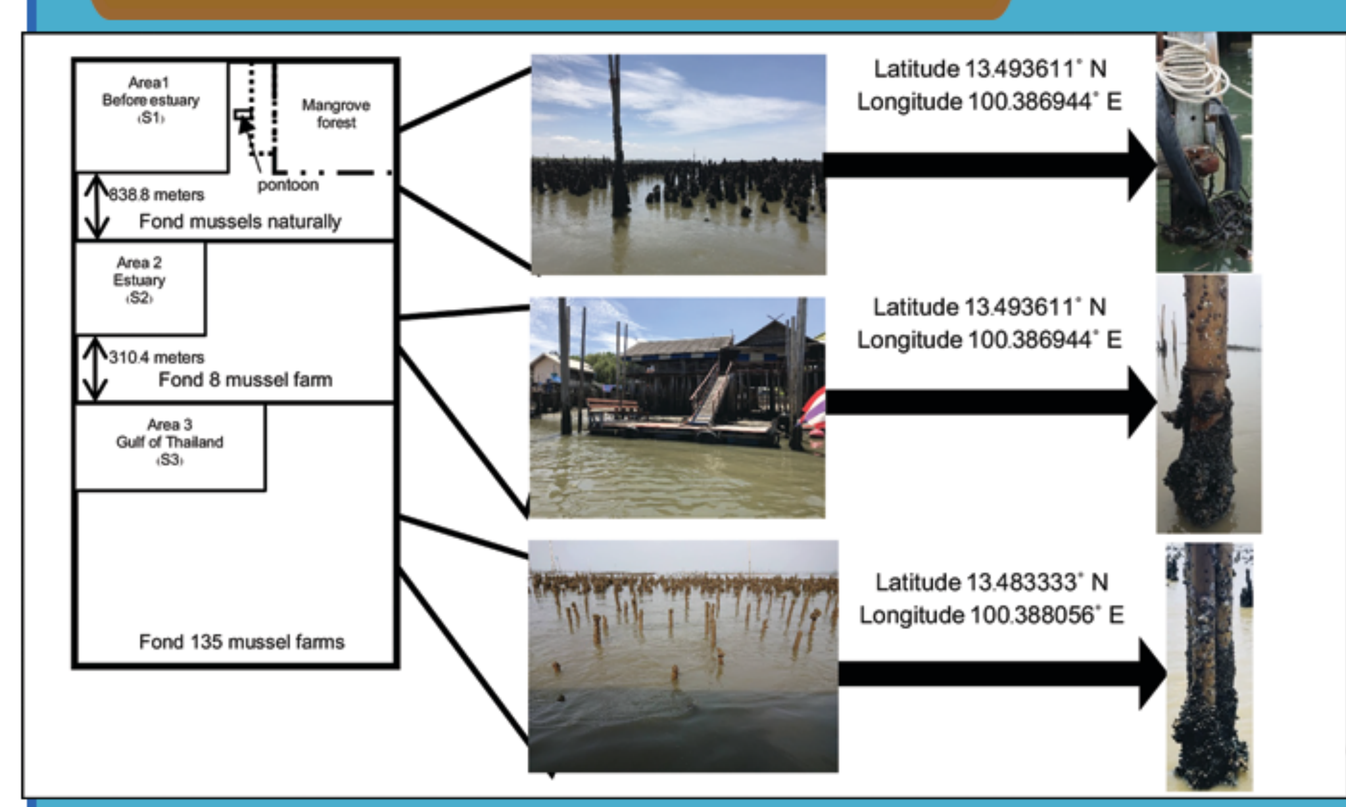
Physical factors of sea water that affect the growth of mussel are temperature (Manoj, 2003) salinity (Sukhum, 2004) dissolved Oxygen (Suntree, 2011) turbidity (Mackie, 2010) and flow rate (Nishizaki, 2017)

From the habitats factors, the relationship of physical factors that affect mussel growth, the researchers therefore is interested in studying the ecology of mussels, growth rate and the relationship of mussels on the poles and the relationship between physical factors that affect the mussels growth to be applied to formations of mussels poles that affect the flow rate to increase the growth of mussels *Perna Viridis* on poles in the Gulf of Thailand.



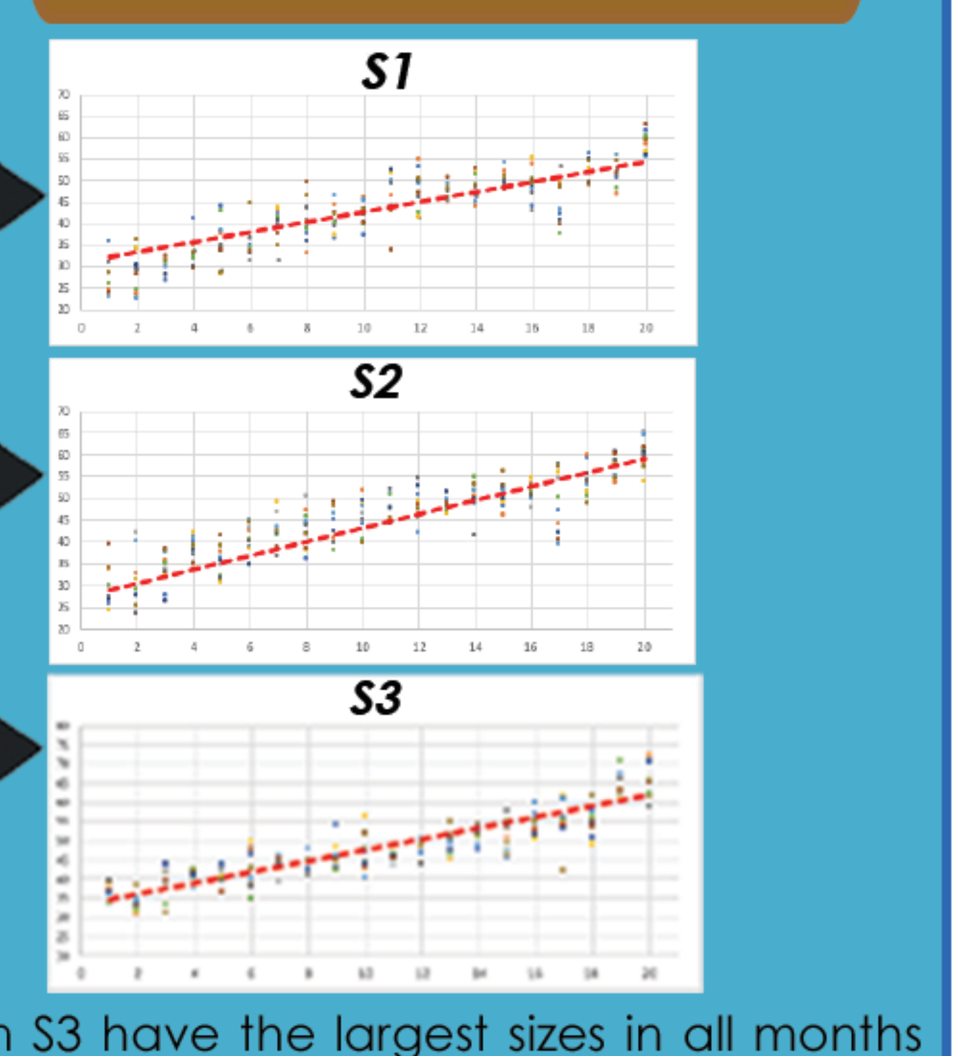
Part 1 The study of the ecology of mussel in the Gulf of Thailand

1.1 The distribution of mussels



The distribution of mussels can be divided into 2 types,the natural distribution and the distribution in the mussel farm.

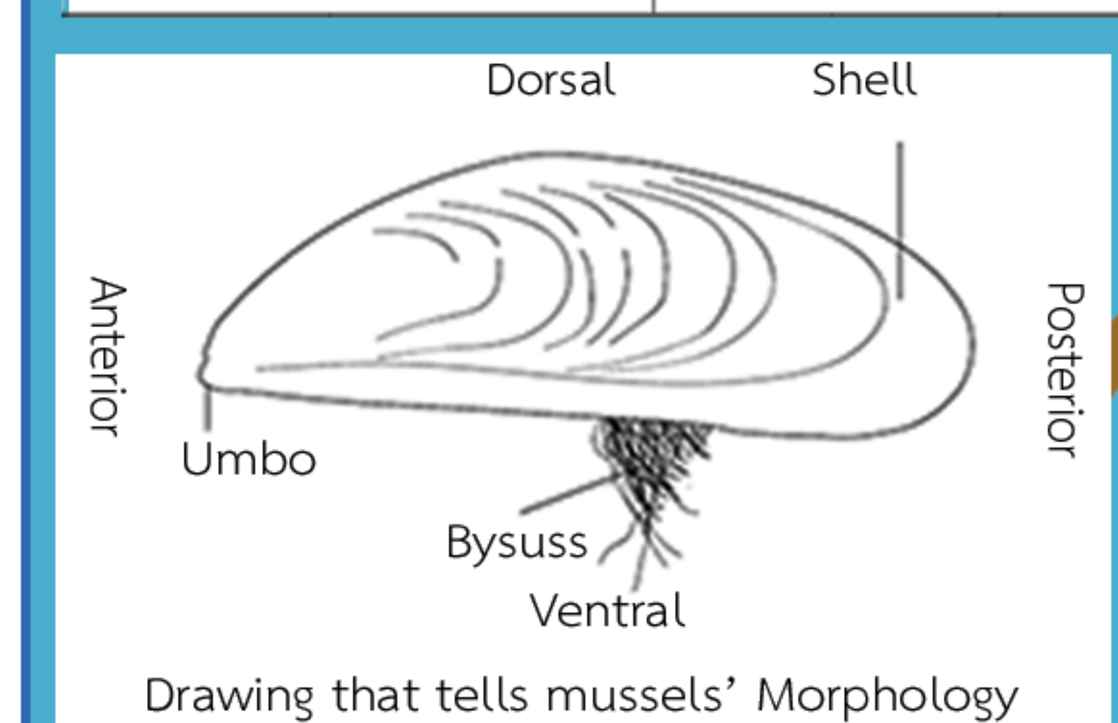
1.3 The growth of mussels



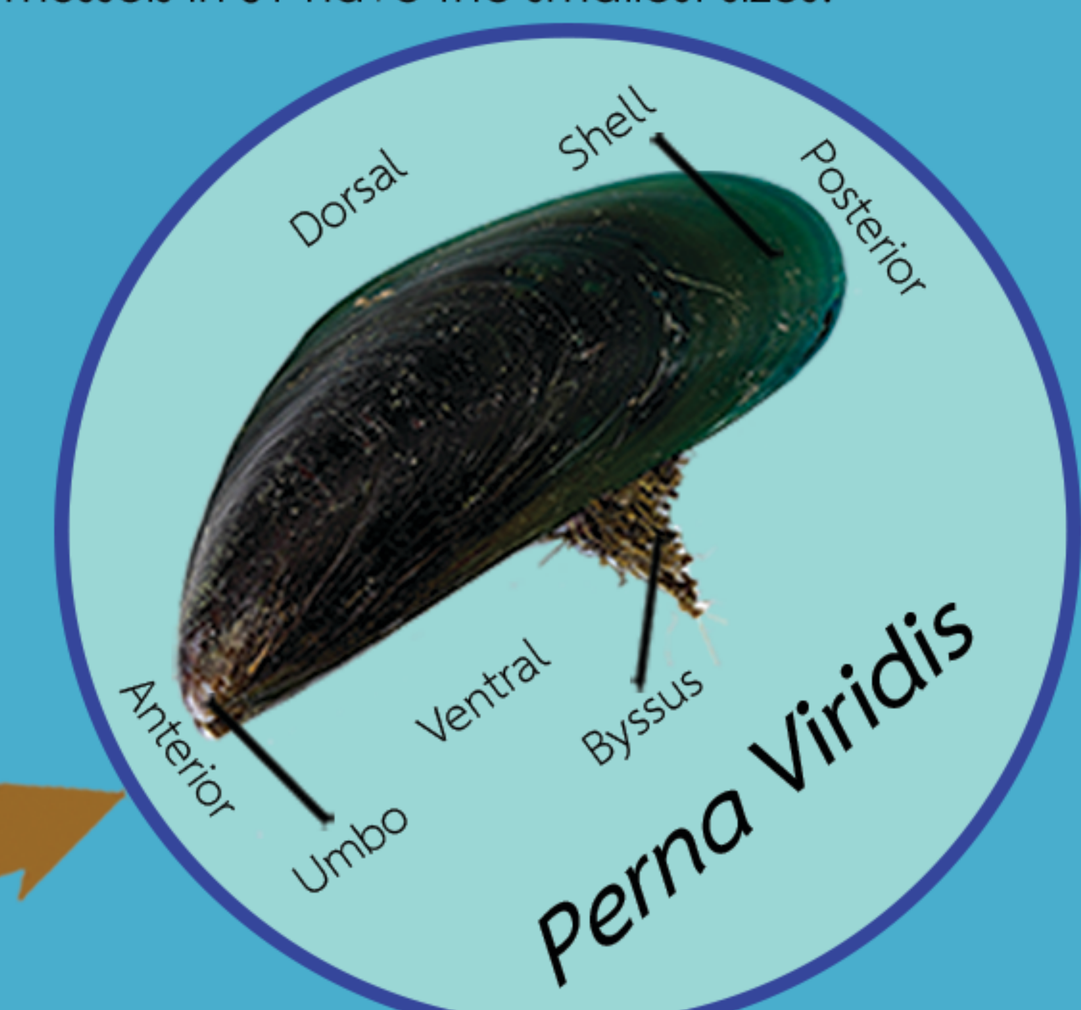
Mussels in S3 have the largest sizes in all months and mussels in S2 have the second largest sizes and mussels in S1 have the smallest sizes.

1.2 Morphology and species of mussels

structure	Number and Picture S1	S2	S3
Perna Viridis - Shell is green and black color and smooth. - Between two shell is more brown than other place.	200	200	200
Perna perna - Shell is brown - Color and shape of shell can change depend on environment	Not Found	Not Found	Not Found
Perna canaliculus - Shell is light-brown and green	Not Found	Not Found	Not Found



Drawing that tells mussels' Morphology



Form the study of specie found only one species: *Perna Viridis*. The details of mussels morphology are in the picture.

GLOBE Badges

Be a Data Scientist

This report has included in-depth analysis of physical factors which are temperature, salinity, turbidity and flowrate by using GLOBE Protocol for measuring and has sent data to GLOBE Data Entry, biological factor which is number of barnacles and growth of mussel. Moreover, I have collected data from other sources form i nterviewing local farmers and investigating real mussel farm. All of the data were collected for 6 months 20 times and the total of 36,000 data to get enough data for analyzing. Next, I compared the average of the data to find the trend of the relationship between physical factors and the growth of mussel. After that, I studied the relationship of the data by using Correlation. Then I applied them to increase the growth of mussel and revenue for farmer who are farming mussel.

Be an Engineer

I have used the engineering knowledge about design formatting the mussel poles. Form observing, different formation of mussel poles affect flowrate differently. So, I used this information to create new formation of mussel poles. If the water flows faster, the mussels will grow better. Therefore, I tried to create new formation which can make water flow faster which has the same area and number of poles as the original way of formatting mussel poles. If the mussels grow better, it will fitter the water and help the global environment.

Make an Impact

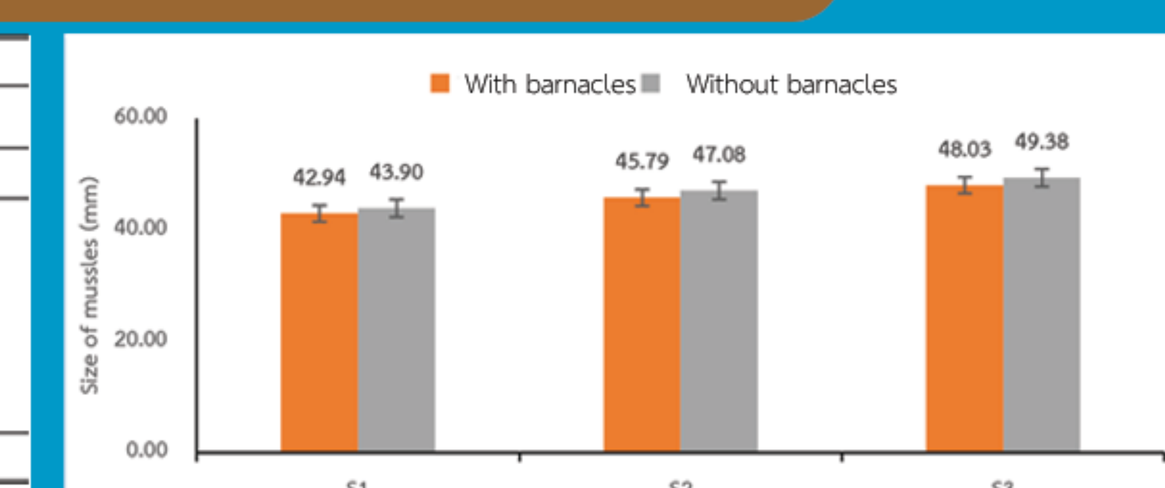
Nowadays, the mussels are smaller and making the farmers have less revenue. This make me wanted to find a way that can increase the growth of mussels and using the same cost. If this research can increase the size of mussels and make famers receive more revenue, the economy would be better. Moreover, the mussels have the ability which can filter water. Therefore, the water in area that have mussel farm would be better. When I did a experiment in real farm, I found that the new formation of mussel poles which I has created can increase the revenue for farmers by 6,280.66 USD or 28 percent when compared to the original way of formatting mussel poles.

Materials & Methods

Part 2 The study of the biological and physical factors affecting the suitability of mussel habitat

2.1 Biological factors that affects the mussel habitat suitability

month	Size of mussels with and without barnacles (mm) S1 with	S1 without	S2 with	S2 without	S3 with	S3 without
April	29.29	30.20	33.00	33.97	37.84	39.21
August	36.86	38.37	41.01	42.43	43.75	44.75
June	46.06	47.02	47.53	48.69	47.84	48.92
July	49.94	50.25	52.78	53.01	51.81	54.05
October	52.56	53.67	54.64	57.29	58.93	59.98
Average (mm)	42.94	43.90	45.79	47.08	48.03	49.38

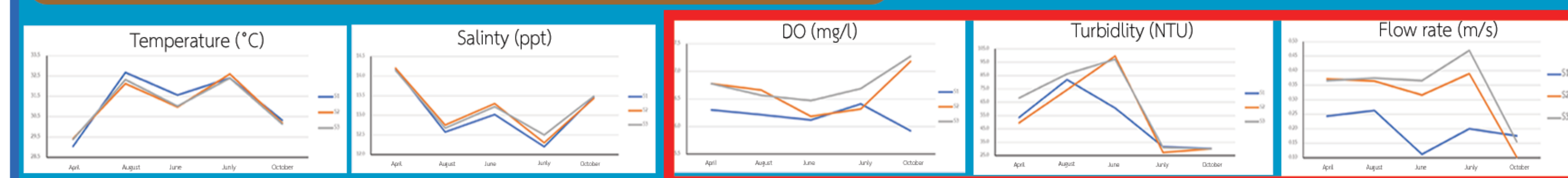


Factors	Correlation
Number of Barnacles with Size of mussels	-.252*

* statistically significant at the 0.05 level

From this table we found that mussel size and number of barnacles have relationship in inverse viration.

2.2 Physical factors that affecting the growth of mussels



Factor	Correlation Temp.	Salinity	DO	Turbidity	Flowrate
Mussels' size	-.528	.882	.955	.959	1.000**

** statistically significant at the 0.01 level

Factor	Correlation Temp.	Salinity	DO	Turbidity	Flowrate
Number of Barnacles	-.083	.216	-.044	-.134	-.688**

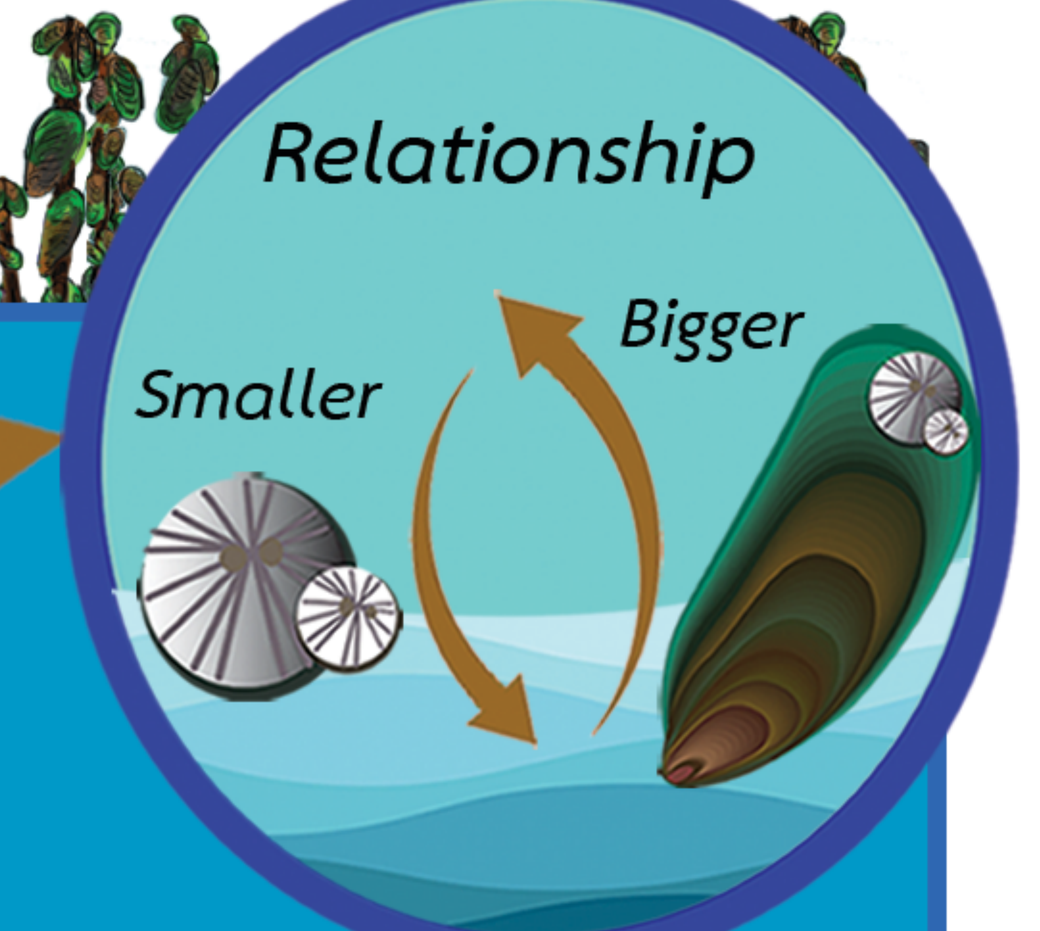
** statistically significant at the 0.01 level

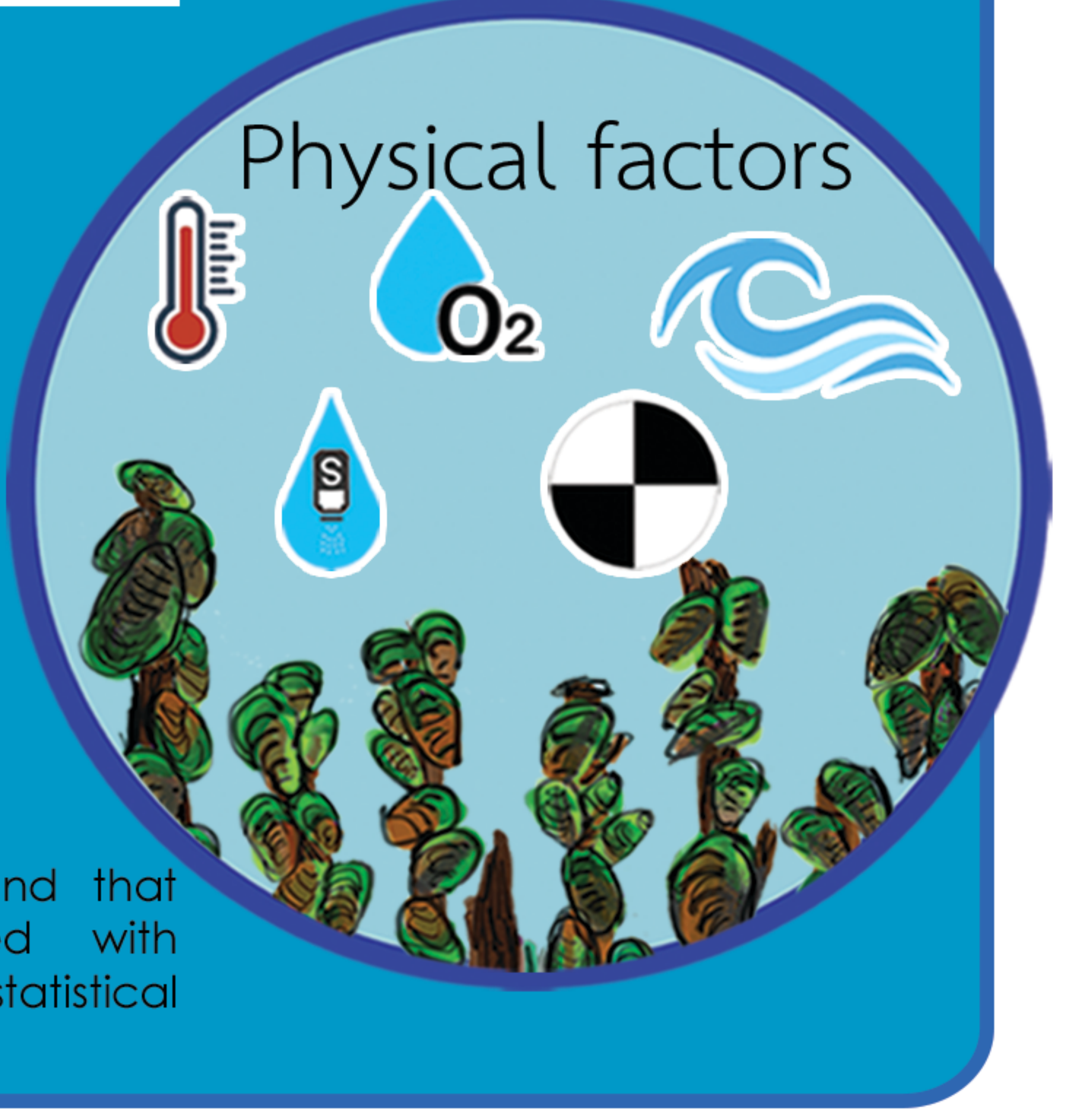
From studied the relationship by using correlation analysis, I found that flowrate is correlated to the growth of mussels in direct variation with statistical significance.

Factors	Correlation DO	Turbidlity
Flowrate	1.000**	.962

** statistically significant at the 0.01 level

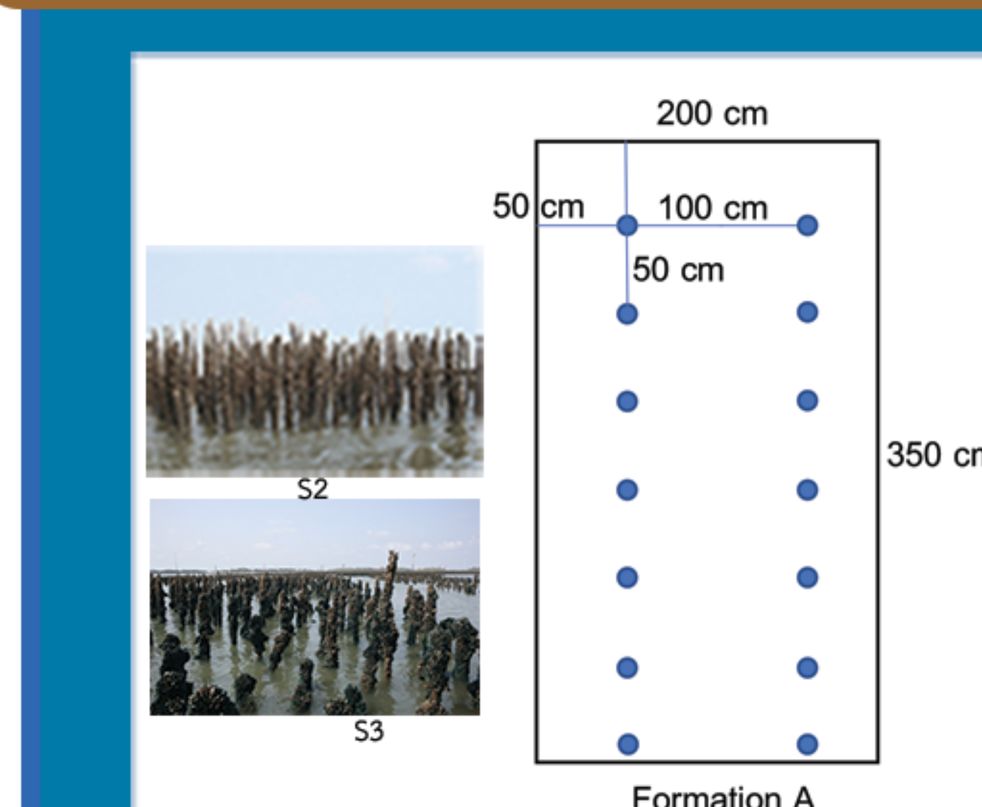
From this table, I found that flowrate is correlated with dissolved oxygen with statistical significance.





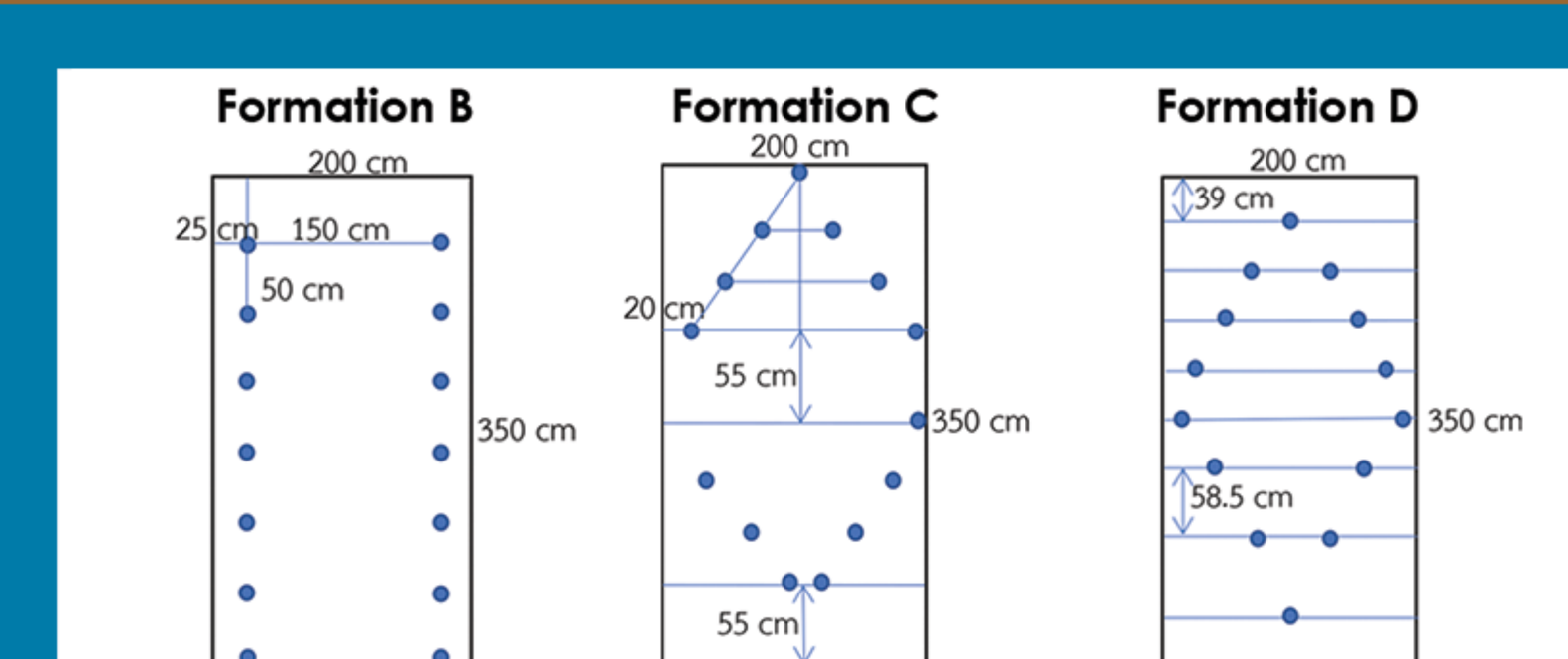
Part 3 The construction of a suitable habitat for increasing the growth of mussel

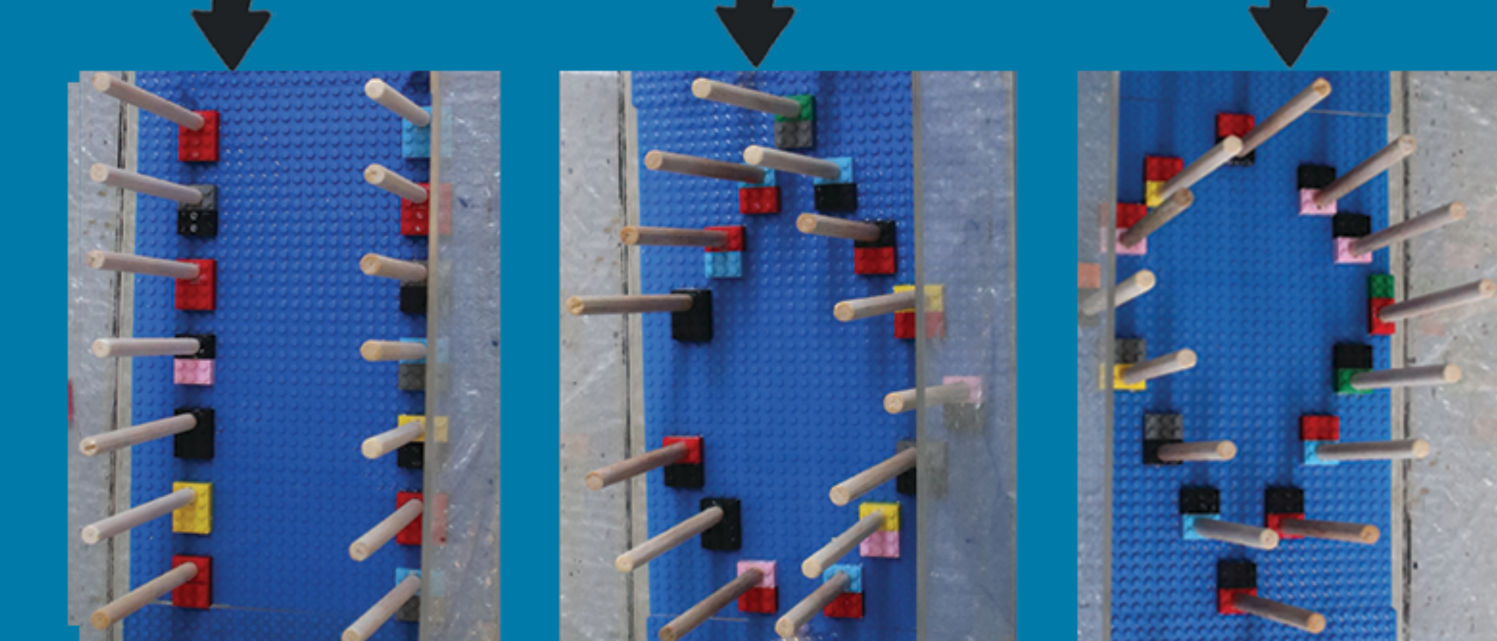
3.1 The habitat of mussel which are created by the farmers



When set the mussel poles studying area as 70 square meters, found the poles in total of 14 poles. The distance between pole is 50 cm and the distance between row is 100 cm. I defined this as "Formation A"

3.2 The creating of a suitable habitat for framing mussel





From the studying of researches and journals, researcher applied the formation of mussels poles into 3 formations

3.3 The experimentation of a suitable habitat for mussels in each formation

Formation	Flowrate (m/s) Before	After	Difference
A	0.26	0.18	0.08
B	0.22	0.22	0.00
C	0.26	0.21	0.05
D	0.24	0.25	-0.01

Formation	Flowrate (m/s) Before	After	Difference
AAA	0.64	0.13	0.51*
BBB	0.65	0.16	0.49*
CCC	0.65	0.18	0.47*
DDD	0.64	0.27	0.37*

* statistically significant at the 0.05 level

From the experiment, found that formation D affect flow rate to change the least and when increase to 3 farms it is still affect flowrate the least.

Month	Flowrate (m/s) formation A Before	After	Difference	Formation B Before	After	Difference	Formation C Before	After	Difference	Formation D Before	After	Difference
December	0.25	0.16	0.09	0.20	0.15	0.05	0.21	0.16	0.05	0.19	0.19	0.00
January	0.17	0.12	0.05	0.18	0.14	0.04	0.19	0.14	0.05	0.19	0.20	-0.01
February	0.20	0.15	0.05	0.19	0.16	0.03	0.20	0.15	0.05	0.20	0.20	0.00
Average	0.20	0.14	0.06*	0.19	0.15	0.04*	0.20	0.15	0.05*	0.19	0.20	0.00

* statistically significant at the 0.05 level

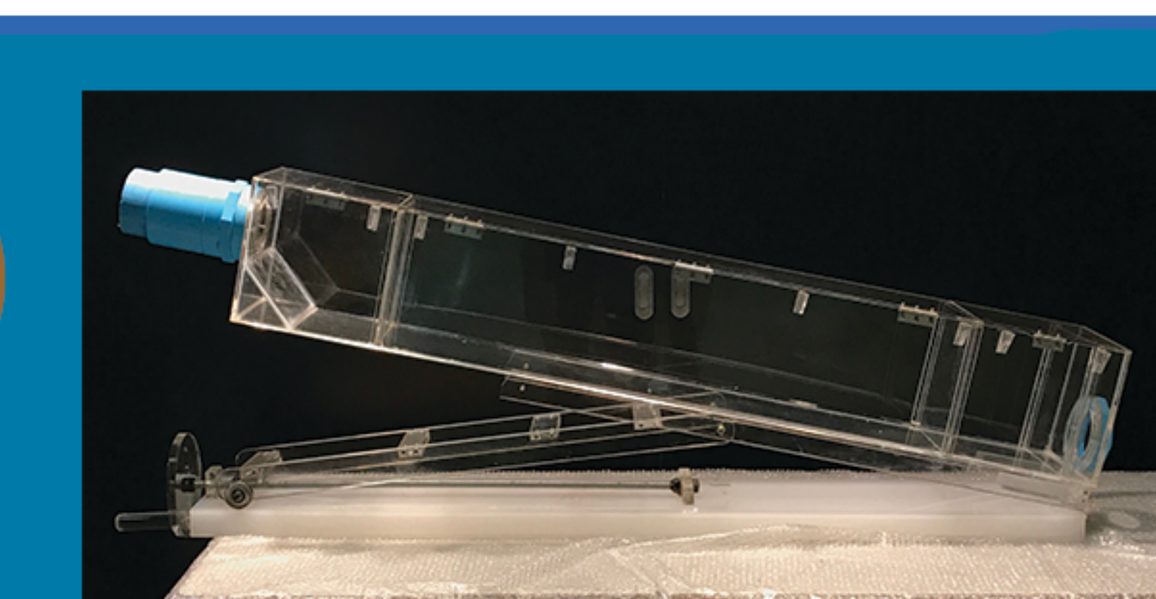
Month	Size of mussel (mm) Formation A	Formation B	Formation C	Formation D
December	29.28	33.92	30.47	34.53
January	35.43	38.20	37.34	40.24
February	43.12	47.67	45.05	48.47
Average	35.94	39.93	37.62	41.08*

* statistically significant at the 0.05 level

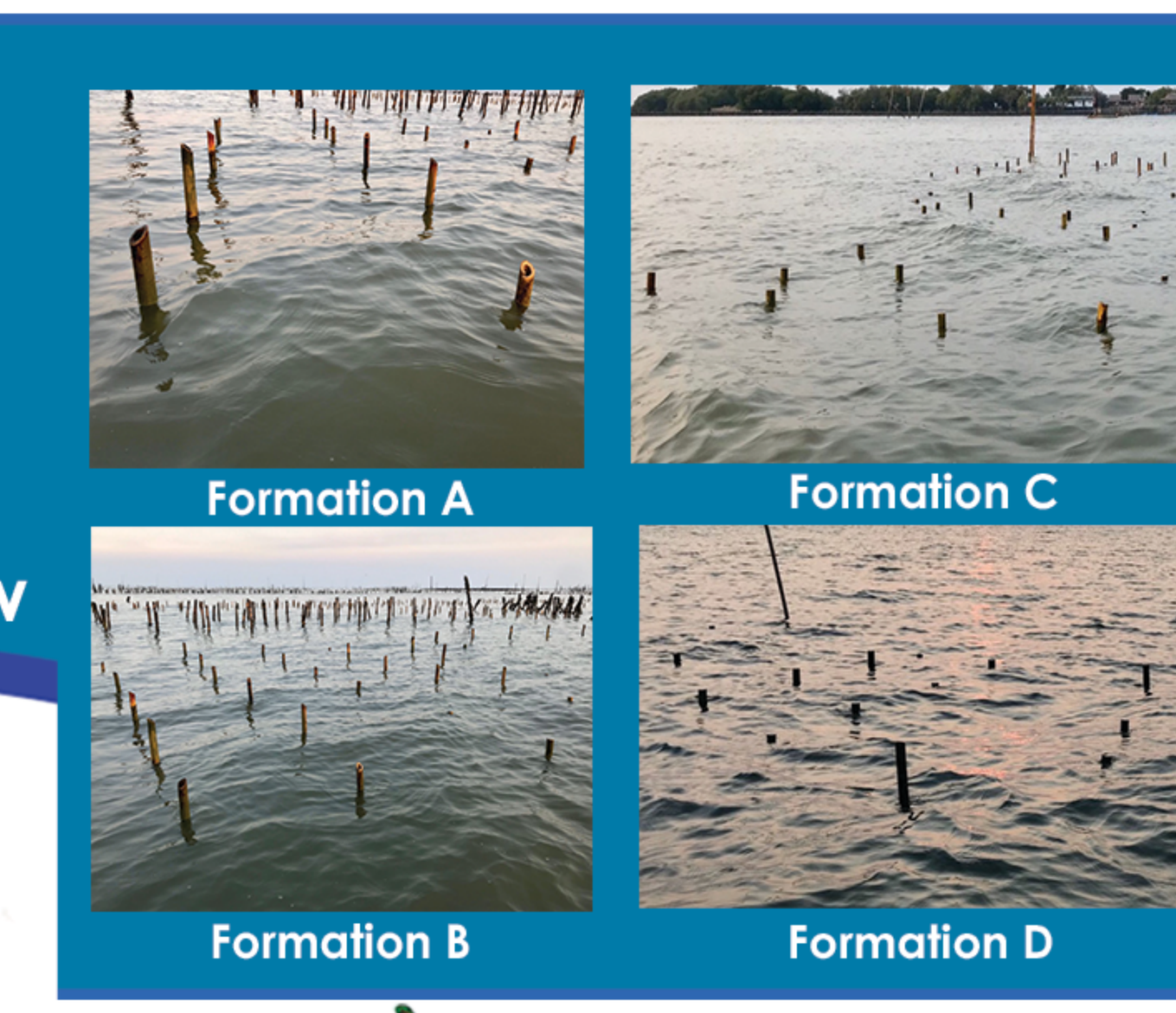
From the experiment, in real farm, found that formation D affect flow rate to change the least and also makes mussel grow the best.

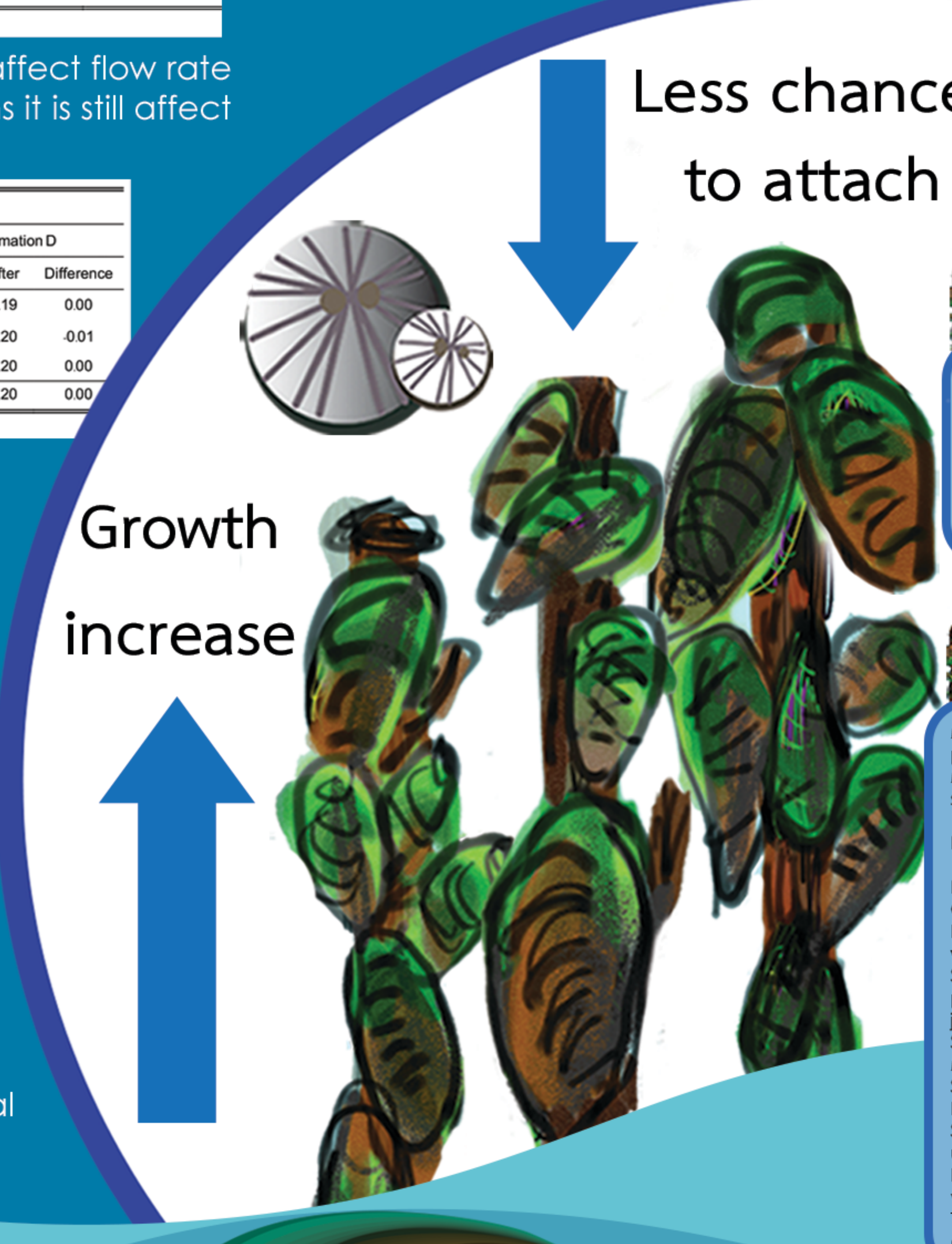
Formation	Weight per farm (kg)	Revenue per farm (USD)	Revenue per 1,600 square meters (USD)
A	133.56	296.99	22,274.14
B	138.18	307.26	23,044.63
C	146.30	325.32	24,398.82
D	171.22	380.73	28,554.80

When calculate the revenue, found that Formation D can increase the revenue compared to the original way by 6,280.66 USD.



Tube that simulate water flow





Discussion

Part 1 The study of the ecology of mussel in the Gulf of Thailand

After studying ecology of mussels in the Gulf of Thailand , I found that there are 2 types of mussels' distribution, the first one is the naturally distribution which is before the estuary and on the pole. All of them are the same specie of mussel which is Perna Viridis. After that we study the growth of mussels by measuring all the mussels sample, we found that mussels in S3 are the biggest. The mussels size are 48.74 mm., 46.45 mm., 43.43 mm. in the following oder. All area have statistical significance differences.

Part 2 The study of the biological and physical factors affecting the suitability of mussel habitat

After studying the factors that affects the mussel habitat suitability, and studying the biological factors, I found that barnacles affect the growth of mussel by competing with the mussel in consuming food. After studying the physical factors, I found that dissolved oxygen, turbidity, and flowrate in each area are different with statistical significance. Then I studied the relationship by using correlation analysis and found that flowrate is correlated to the growth of mussels in direct variation with statistical significance. After studying the correlation between biological and physical factor, I found that flowrate is correlated with the number of barnacles in inverse variation with statistical significance. After studying about correlation among physical factors with statistically significant difference in each area, I found that flowrate is correlated with dissolved oxygen with statistica significance.

Part 3 The construction of a suitable habitat for increasing the growth of mussel

After studying the flowrate of water before and after passing through the habitat of mussels, I found that mussel poles is affecting the flowrate. After investigating the way that farmers create the habitat of mussels, I found that in the 7 square meters there are the total of 14 poles. After that I studied about the formation of mussel poles that won't affect the flowrate and got 4 new formation of mussel poles. Then I conducted the experiment in the tube that cans imulate water flow with all 4 formations and found that formation D, which is the tear-drop shape according to Nancy, 2015, has the least effect on flowrate. After adding the number of mussel poles form 1 farm to 3 farms, I found that formation D is still the formation that affect flowrate the least. Formation D is also the formation that has the least effect on flowrate and has the highest growth of mussels when tested in the real farm. When calculated the revenue, this formation increases the revenue by 6,280.66 USD or 28 percent.

Conclusion

In conclusion, to create a suitable habitat for the growth of mussels, formation D should be used for farming mussels as it affects the flowrate the least. Test of formation D in real farm also results in increase of mussel growth with statistical significance.

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