**Effects of Detergent on the Tentacle Movement of *Metridium Senile***

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**Abstract**

The *Metridium senile*, frilled anemone, lives in the Atlantic ocean feeding on small crustaceans and larval forms of some mollusks. What will be tested is the effect of detergent on their tentacle movements. After performing the tests, it was found that the detergent had a negative effect on the anemones, causing their tentacle movements to decrease dramatically. It was found that C, being a juvenile, was an outlier, and was not fully considered in the final analysis. However, in conclusion the detergent caused the anemones to move their tentacles less due to a lack of magnesium and calcium ions due to the water softeners.

**Introduction**

The purpose of this lab is to show what the effects of detergent are on the *Metridium senile’s*, Frilled Anemone, tentacle movements. This will be shown through a series of trials with increasing amounts of detergent in each. The *Metridium senile* is found on Atlantic coasts of the United States, and several European countries including the UK and Ireland as well as in the arctic (Fautin 2011). It can grow to be about 12 inches tall in some cases, depending on how much food they have as well as the open space around them. Their color can range from a pale yellow to a burnt orange, and they have anywhere from one to several lobes. Each lobe can contain hundreds to thousands of small, feather like tentacles. Once in the polyp stage, they can attach to various substrates including rocks, sand, wood, and most bivalves (ex: blue mussel). Once attached they can trap larval forms of some mollusks and small, microscopic crustaceans like zooplankton. They have only a few predators, the major one being the northern sea star, Asterias amurensis. Their ecological niche, as a ‘filter-feeder’, is to consume the plankton drifting down to the seafloor, helping to keep it clean. An adaptation that they have developed is their ability to change their height depending on tides and current strength. This allows less drag on them, therefore decreasing their energy usage (Anemones and...).

There are male and female *Metridium seniles*, however they still reproduce asexually. The male has the ability to release sperm into the water, and when it comes into contact with the female, fertilization occurs internally. Once this occurs, they will bud, forming a new, juvenile frilled anemone. Another way they can reproduce is when part of the base becomes detached, it can actually grow and form a new anemone (Anemones and...).

When the *Metridium senile* eats, several things have to happen. The first step is that the nematocysts have to discharge mucus at their prey, stopping it and causing it to drift down. Once the prey is on the oral disk, base of tentacles (see below), it is brought down into the mesentery where the nutrients are absorbed (Batham 1951). As this is all happening, the oral disks contract, bringing in the tentacles, and closing the anemone. It will stay in this state until it needs to feed again.

The part of the anemone that will be focused on in this experiment is the oral disk division of their muscle-fibers. This is what controls the movement of the tentacle. The muscle fibers that are used by the *Metridium senile* can be up to 1mm long, however they are only 0.5µ thick. These can contract to about one fifth of their original length, allowing for very versatile movements, and all of the fibers are connected in the inside of the anemone (Batham 1951). The way the tentacles move is the contraction of the oral disk. The oral disk is the circular base from which the tentacles protrude from. The oral disk naturally contracts and relaxes through out the day, however food and an external stimuli, such as touch can also cause it to contract (Batham 1950). The basis from which this experiment worked was upon the natural movements that occur. In order for contractions to take place, ions must be in the anemone’s surroundings. In a study done at the “Cambridge Zoological Laboratory” in 1953 it was found that certain ions, such as MgCl2, increase the tentacle as well as other movements in the *Metridium senile* (Batham 1953). The detergent used, *All Free and Clear*, has water softeners in it. Water softeners are chemicals, such as a sodium ion, that take calcium and magnesium ions out of the water. As stated above magnesium was a factor in the movement of tentacles.

**Hypothesis**

If the detergent amount is increased in the tank, then the tentacle movements presented my the *Metridium senile* will decrease due to the loss of magnesium ions in the water.

**Materials**

* Three *Metridium seniles* (A, B, and C)
* Two Tanks
* Ocean Water
* Detergent (*All Free and Clear*)
* Thermometer
* Container (Big enough to place a single tank in)
* Ice
* Graduated Cylinder
* Large Beaker- 1000ml
* Stirring rod

**Method**

For the first control, 800 ml of seawater at 15C was placed into a tank. The tank was then placed in the container with ice. The ice was spread around the perimeter so that the temperature was stable. Then, anemone’s A and B were placed into the tank, and they were given 5 minutes to adjust to the new environment. Once adjusted, they were observed, one at a time, for five minutes, counting all tentacle movements\*. Once the data was received, it was recorded in a table.

For the second control, 800 ml of seawater at 16C was placed into a tank. The tank was then placed into a container with ice, making sure ice was touching the edges. After anemone C was placed into the tank, it was given 5 minutes to adjust. After the 5 minutes were over, the tentacle movements were counted for five minutes, then recorded in a table.

A and B’s trial one started with 800 ml of seawater at 15C. After the tank was again placed in a container with ice, the anemones were given 5 minutes to adjust. After the initial 5 minutes were up, 1 ml of the detergent was added, and stirred. Once mixed well, they were given another 5 minutes to adjust. After they had adjusted, their tentacle movements were recorded, one anemone at a time, for five minutes. After the data was collected, it was put into a table. This was repeated with 2 ml and 4 ml, all on different nights.

For C’s trial one, it was placed in a tank with 800 ml of water and given 5 minutes to adjust. After the initial 5 minutes, 1 ml of detergent was added to the tank, and it was stirred until well mixed. After it was mixed, it was given another 5 minutes to adjust. Once adjusted, the tentacle movements were timed for 5 minutes, and the number was recorded in a table. After it was complete, 1 ml more of the detergent was added into the tank, and it was given another 5 minutes to adjust after stirring. Again the movements of the tentacles were recorded for 5 minutes after it was adjusted, and then the number was added to the table. For trial three, 2 ml was added to the tank (meaning a total of 4ml in the tank). Another 5 minutes of adjusting later, the tentacle movements were recorded for 5 minutes, and the number of movements was recorded in the table.

\*A tentacle movement was defined by a clear contraction of the oral disk, resulting in a distinct, sharp movement of the tentacle.

**Data**

**Control**

| Anemone | Temperature (C) | Tentacle Movements |
| --- | --- | --- |
| A | 15 | 186 |
| B | 15 | 6 |
| C | 16 | 170 |

**Trial One- 1ml Detergent**

| Anemone | Temperature (C) | Tentacle Movements |
| --- | --- | --- |
| A | 15 | 124 |
| B | 15 | 12 |
| C | 16 | 109 |

**Trial Two- 2ml Detergent**

| Anemone | Temperature (C) | Tentacle Movements |
| --- | --- | --- |
| A | 15 | 87 |
| B | 15 | 7 |
| C | 16 | 78 |

**Trial Three- 4ml Detergent**

| Anemone | Temperature (C) | Tentacle Movements |
| --- | --- | --- |
| A | 15 | 69 |
| B | 15 | 8 |
| C | 16 | 49 |

**Graph**

| **Anemone** | **Control** | **Trial One** | **Trial Two** | **Trial Three** |
| --- | --- | --- | --- | --- |
| **A** | 186 | 124 | 87 | 69 |
| **B** | 6.0 | 12.0 | 7.0 | 8.0 |
| **C** | 170.0 | 109.0 | 78.0 | 49.0 |

**Results**

For the control, A’s tentacles were 186, B’s were 6, and C’s were 170. In this set of data, it is clear that B is an outlier. Going to Trial one, A’s mvements decreased by 62, or 33%, showing that the detergent did effect the movement of it. B’s movements doubled, going to 12. This, again, shows that B is an outlier. Finally, C’s movements dropped by 61, or 36%. From trial one alone, it is shown that the detergent lowered the number of tentical movements dramatically for anemones A and C.

Trial two showed similar results on anemones A and C when compared to trial one. A decreased it’s movements by 37, or 30%. This is only a 3% difference when compared to the results from trial one. B, again was an outlier and decreased by 5, or 42%. C’s movements decreased by 31, or 28%. This shows a meer 8% difference in drops from the previous.

For the final trial, trial three, A and B again were still decreasing, while C was again an outlier. A’s tentacle movements decreased by 18, or 21%. Notice, this is much lower than the previous drops. B’s movements rose by 1, or 14%. Finally, C’s movements decreased by 29, or 37%. This decrease was 9% larger than the previous one.

**Conclusion**

After overlooking the data, there are a few anomolies. Starting with Anemone B, it was observed that the tentacles did not move anywhere near the amount that the other two, A and C, did. After re-identifying with another field guide, it was found that it’s longer tentacles meant that it was a jounvenille *Metridium senile.* As the jouvenille of *Metridium senile* did not move as much, it was determined that this was an outlier due to it’s imauturity. Another explaination for the lack of tentacle movements could be that because their tentacles were longer, it took more energy to move them. If this was the case, it explains why there were not as many oral disk contractions, or tentacle movements, as witnessed by A and C.

The trend, as seen by the graph, was downwards as the detergent amount increased (again, excluding B). Over the course of the experiment, A’s tentacle movements dropped by 63%, meaning something did happen that caused it’s oral disk to not contract as much. C’s tentacles dropped as well, but with a total of 71%. Both A and C’s movements dropped with only a 8% difference bewteen thir final numbers. ONe reason this could be is that the water softeners in the detergent salidified so much of the calcium and magnesium, that they didn’t have enough ions to move their tentacles as much. As seen in the study performed at the Cambridge Zoological Labs in 1953 by Batham and Pantin, Magnesium does affect the rate at which the anemone’s muscle-fibers can contract. So, because the softeners decrease the amount of magnesium, it decreases the amount of contraction occuring (Batham 1953).

The reason the *Metridium senile* needs magnesium, as well as other ions such as calcium and sodium, to contract their muscle fibers is due to action potential. Action potential is the depolarization that occurs after a stimuli. Once created, the action potential propogates to the fiber telling it to contract, or relax. This is all done, however, with no nerves (Batham 1953).

On trial three, A’s movements decreased by a much smaller percentage, while C’s decreased by a larger percent. This difference could have been caused by the fact that all tests performed on C were on the same night, meaning it spent more time in the detergent solution. Because it was in the detergent solution for longer, the effects of it might have been worse, meaning the percentages would stay stable, or decrease by more as time went by, which is what happened in trial three. The reason A’s movements decreased by smaller percentages as time went by could have been because it had become used to the effects, meaning it could contract it’s fibers more efficiently.

The reult of this drop in tentacle movements would result in less feeding in the wild. This is because it would be moving its tentacles less, meaning it will not have as many opportunities to trap prey. However, it would use less energy because it would be moving less. However, if it continued to not have as many ions in its environment, it may adapt to need less calcium and magnesium per contraction, resulting in a new adaptation.

**Work Cited**

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