Hopkins Pond Blue-Green Algae Cleanup

Haddonfield Naval Engineers

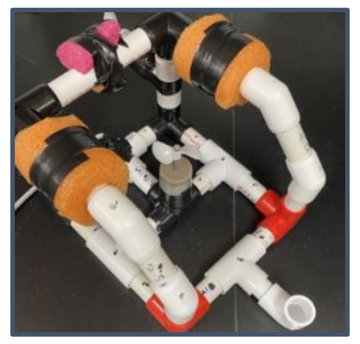
Haddonfield Middle School, 5 Lincoln Avenue (Haddonfield, New Jersey, United States)

I - Abstract

Our team's project was to research an environmental issue and apply that knowledge by determining solutions that could be effectively carried out by our SeaPerch. We selected our issue via group discussions about project ideas. Members came to the conclusion that decontamination efforts at our local park, Hopkins Pond was both topical to naval engineering and a personal, familiar issue to our team.

Based on our research and general understanding of the issue, the team anticipated that the craft would need to be modified to be able to carry and deposit some type of substance (chemical or organism) into the contaminated water. The plan is to put a plan in place to permanently clean this body of water using natural means.

Real World Application Goal:
Create a solution to clear the contaminated local body of water utilizing the SeaPerch design to do so.



A body of water located at Hopkins Pond.

V - Next Steps

End of Phase I: The next steps begin with monitoring our implementation at Hopkins Pond. Based on our research, the process of cleaning up this size body of water will take a full year of seasons to know how well the implementation has worked. To start, we've mapped out locations within Hopkins Pond (shown below) to deposit the capsules with our craft.

Our points of capsule deployment are marked on the map with a dark blue x and our craft release points are marked with a red x.

After a year of monitoring the growth of Blue-Green Algae in this body of water for a year we can gauge phase II of the implementation.

Phase II: We can scale the construction of craft's to mass production and give it to our neighboring towns, working closely with them in order to address the severity of the algae situation. Then, we can continue expanding, getting our craft out to every town in America with this problem. Finally, we will go international and help communities in need all over the world. Once successful international, we can modify our craft and add specific storage units on our craft just for the capsules. We can also alter the dimensions for larger and smaller bodies of water.

Questions for future exploration:

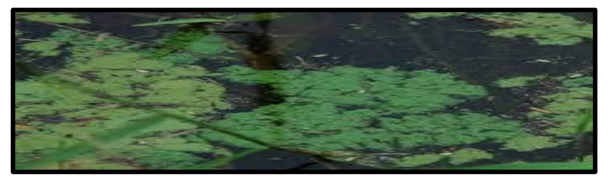
- Are there other modifications that can be made to the craft to carry out our solution more effectively?
- Is our solution to the algae problem applicable to different situations and circumstances?
- Should we consider partnering with other organizations to spread awareness of the issue and promote our work?

II - Background & Motivation

The real world application challenge that became part of the competition this year challenged our team to answer the question, **"How can our SeaPerch be used to solve a problem in the world around us?"** We thought it would be interesting to investigate how to combat a natural force (algae) without disrupting the environment as a whole

Hopkins Pond is a local body of water that has been overrun by Blue-Green Algae, which is a problem for many communities. We chose the issue of algae cleanup at Hopkins Pond specifically because it affects our local community and ecosystem. This algae needs to be contained as it is consuming the pond and has the possibility of becoming toxic. If left unattended to, the risk of toxic blumes from the algae will increase.

This problem can be harmful to our town, its residents living nearby, and the wildlife living in the woods in the surrounding area. Blue-green algae is actually a bacteria that has similar qualities to algae and is found in rivers, ponds, and lakes. Blooms are common, but a few blooms may produce neurotoxins and hepatotoxins. **If we can solve this problem in our town, we can provide a model for other towns with the same problem.**



If we don't do something, who will?

VI - Conclusion

We decided that our local Hopkins pond was in desperate need of algae removal. After further research, we learned that the algae was a bacteria called blue-green algae. We also learned that it had the possibility of creating toxic blooms. We then discovered that certain plants decrease phosphate which the bacteria needs to survive. We decided to approach this issue by filling biodegradable capsules with the seeds of the plants. We'll execute our plan by releasing them in the pond utilizing our craft. The seeds will be dispersed in specific areas around the pond. Within a year, the seeds will grow and start the process of starving the bacteria, with the end goal of eliminating the bacteria all together. The pond will then be free of the harmful bacteria, the ecosystem would start its long recovery process, and the people living nearby will no longer be at risk of the toxins. This project enabled our team to experience firsthand the use of ROVS in the field, and it will also benefit our community.

Haddonfield Naval Engineers removing toxic Blue-Green Algae, one capsule at a time

The members of the Haddonfield Naval Engineers

III - Methodology

We approached our project by tasking group members with researching the algae in Hopkins Pond. The main source of information came from investigations that had been conducted on the area, specifically news articles and science blogs. Our research team consulted these sources to understand the scope of the Hopkins Pond algae problem. Our team discovered that the algae in Hopkins Pond was known as *Microcystis*, also called blue-green algae.

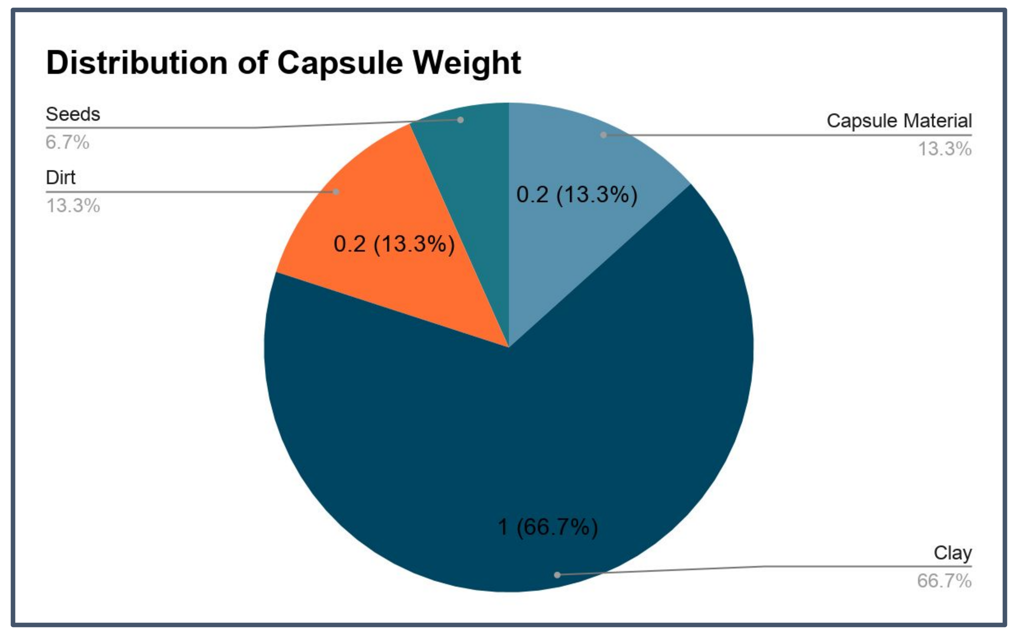
According to the US EPA, the algae can:

- **Produce extremely dangerous toxins that can sicken or kill people and animals**
- **Create dead zones in the water**
- **Raise treatment costs for drinking water**
- **Hurt industries that depend on clean water**

(US EPA, https://www.epa.gov/nutrientpollution/harmful-algal-blooms, 2021)

After identifying the cause of the problem, the team's perspective shifted to finding to a solution. We researched methods of eliminating the algae that wouldn't harm the ecosystem, coming to the conclusion of releasing seeds from our ROV in certain areas of the lake. We had to run tests on our gel caps to inform us of crucial information such as how long it takes for them to dissolve, as well as how to achieve negative buoyancy, causing them to sink to the bottom of the pond, where the seeds can take root and flourish.

How do we create a distribution method for the seeds for best results?



VII - Acknowledgements

Thank you to our wonderful mentor Mr. Kozak for guiding us through different aspects of the project and facilitating experiments, meetings, and group discussions. Our accomplishments and findings would not have been possible without him.

Our team also wanted to thank the JCC for providing us with a pool to test our craft in. They gave us an opportunity to evaluate our craft's performance in a much more effective way than we have been able to for the duration of our work due to COVID-19 restrictions.

References:

Minnesota Pollution Control Agency, "Blue-Green Algae and Harmful Algal Blooms." *Minnesota Pollution Control Agency*, 14 July 2020, www.pca.state.mn.us/water/blue-green-algae-and-harmful-algal-blooms .

Washington State Department of Health, "Blue-Green Algae." *Washington State Department of Health*, www.doh.wa.gov/CommunityandEnvironment/Contaminants/BlueGreenAlgae

IV - Results & Discussion

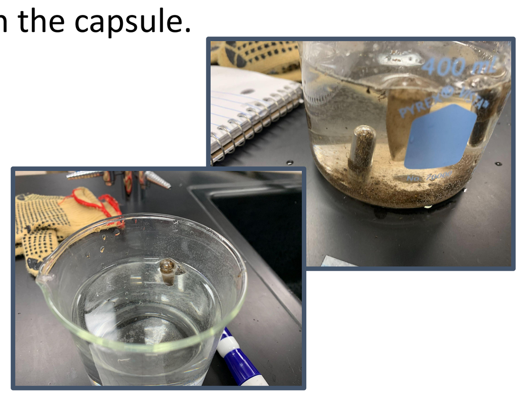
Microcystis (commonly known as blue-green algae) is highly resistant to climates of varied temperatures and changes in light consumption. It can also survive if the composition and content of its nutrient intake changes. These immunities of blue-green algae demonstrate why it persists for so long in a given ecosystem. Members were surprised at how resilient the algae was to different conditions.

With this information, we were able to determine from further research that Eleocharis Yokoscensis, a self-managing, non-invasive underwater flowering plant is our best bet for effectively eliminating the blue-green algae. Eleocharis Yokoscensis helps to increase oxygen and decrease phosphate levels in an ecosystem. Microcystis depends heavily on phosphate to allow it to create glucose during photosynthesis. By removing phosphate from the ecosystem, the Microcystis will stop being able to support itself and eventually die out. Unlike some of the other solutions that we researched, Eleocharis Yokoscensis prevents future regrowth of the algae by keeping the phosphate levels low. Since other plants don't rely nearly as heavily on this, they will not be affected by the increase of Eleocharis yokoscensis. Additionally, Eleocharis Yokoscensis is native to Hopkins Pond, so it will not disrupt the ecosystem.

After some discussions about methods of depositing the Eleocharis Yokoscensis into the water safely, we concluded that soluble gel capsules containing the Eleocharis Yokoscensis seeds would be least harmful to the ecosystem and the most efficient modification to make to our craft. Our gel capsules weigh 0.2 g and inside the capsules we will place 1.0 g of clay, 0.2 g of dirt, 0.1 g of seeds for a total mass of 1.5 g. Our capsules will also have holes poked in the top and bottom and one around the larger half of the capsule at every ¼ turn. A breakdown of the components accounting for the total 1.5 g mass of each capsule is pictured to the left.

To help achieve this solution we were required to run various experiments and tests on the gel capsules. By filling a capsule with green food coloring, and placing it in a glass beaker filled with water, we were able to discover that it takes approximately 35 minutes for the capsule to dissolve, and that the capsule will not sink to the bottom on its own, or filled with seeds, therefore, it will need assistance to become negatively buoyant. This provided crucial information to us, and caused us to have to make adjustments to our plans. In response to the challenge of making our capsules negatively buoyant, we added clay inside of our capsules to weigh them down. Though we tested many methods, such as utilizing small rocks, and poking holes in the capsules, and we found that using clay was the best choice for weights because it would not impact the ecosystem at Hopkins Pond. The soil in New Jersey is known to have a large clay concentration in its soil. The rocks also functioned properly, but we found that they took up too much space in the capsules to be effective.

The image below shows the part of our experimentation in which we determined the duration of time it would take for the gel capsules to dissolve. The green substance appearing simulates the Eleocharis Yokoscensis seeds being released from the capsule.



Highlighting the process of sinking the seed capsules