# "3D Kelp Farming"

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## ABSTRACT

It is well understood that high nitrate levels contribute to hypoxic conditions in water bodies, which is why there are proactive measures in the U.S to reduce nitrate levels, such as wastewater treatment facilities with caps on nitrate output (1). The problem is, what is being done to reduce nitrate levels from a retroactive standpoint? Kelp forests can help address the world's lack of retroactive nitrate reduction. Kelp forests absorb large amounts of nitrates, and in certain conditions can reduce nitrates in water by more than 10% (2). Why isn't kelp grown in the U.S? The market for kelp in the U.S simply isn't big enough for large-scale kelp farms to be supported. Our group developed a business strategy that markets kelp in an American way, and we created a product that is made for an American palette to broaden the existing kelp market in the US in the hope of reducing hypoxic conditions, and protecting areas threatened by high nitrate levels. Existing kelp products in America come almost solely from Asia, as there are very few kelp farms in the U.S. We have partnered with existing farms in the U.S to come up with a strategy to help bring a new food product to the US-a product that promotes healthy eating, healthy oceans, and tasty food.

Over the summer, this group accomplished two overall goals: creating the building blocks for starting a kelp chip company, and growing our own kelp to understand more about the kelp farming industry. To create this company, many contacts were made through the Baker Institute, cold calling, and our pre-existing contacts in the kelp industry. Market research was done to gather information on people's perception of kelp as a food. We then partnered with local chefs, and restauranteurs to help develop a kelp chip, much like Brad's Raw Kale. The chip uses little additives, and was designed to retain as many of the "natural goodness" of kelp. On the other end, we grew kelp in a 50 gallon tank, using a chiller, halogen lights, a filter, saltwater solution, and nitrate additives. Our kelp continues to grow on Mountaintop, and we continue to work on our entrepreneurial venture for credit through the Sustainable Development department. We plan on entering various competitions, and to gain publicity. Our first event will be at the Allentown TedX event on September 19th.

## INTRODUCTION

Kelp, being a natural filter, is one of the most effective ways to reduce nitrogen and carbon in our oceans. Realizing the necessity to increase kelp growth, our team spent the summer focusing on developing the American kelp industry. We started our project with the objective of developing an added value product for sugar kelp (Saccharina latissima) while simultaneously attempting to grow our own kelp on Mountaintop Campus. At the start of our project we were unsure on which route we would be taking. One of our goals was to have a tangible and realistic kelp-based food option by the end of the summer. Additionally, we also hoped to gain a more developed understanding of how kelp matured from spores to a full plant. The goal was to have successfully grown multiple lines of sugar kelp before the conclusion of the project. Finally, in order to spread awareness about our project and collect information regarding the cooking process, we hoped to reach out to local businesses and restaurants for insight.

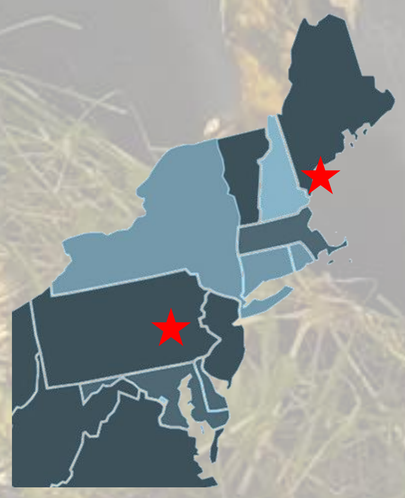

**Figure 1. Map of Northeast America**

**Ocean's Approved** is a kelp farm located in Portland, ME. Our team travelled from Bethlehem, PA 8 hours to collect reproductive tissue from this farm so that we could grow our own kelp up on Mountaintop Campus.

## IN THE LAB

**Figure 2. Sorus Preparation**

Once we returned from Portland, ME with the reproductive tissue, also known as sorus tissue, we quickly began to prep it. This process was time sensitive. The steps we took can be seen in Figure 2.

After preparing the sorus tissue the spores were ready to plant themselves and start growing. Figure 3 shows this process in greater detail.

**Figure 3. Spore Release**

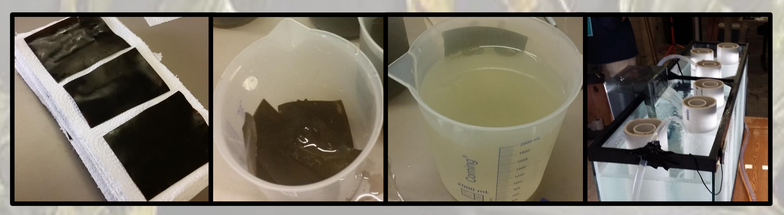

**Figure 4. Sorus Tissue Preparation and Settling Tubes**

## RESULTS

After 10 weeks our tank up on Mountaintop didn't look very promising. It wasn't until our team returned to school that we saw a lot of kelp growth in our tank! Through this process we learned that kelp can be grown in a tank using artificial sea water. We also learned a lot about the nursery procedures for kelp which will be helpful if we ever decide to start our very own kelp farm.

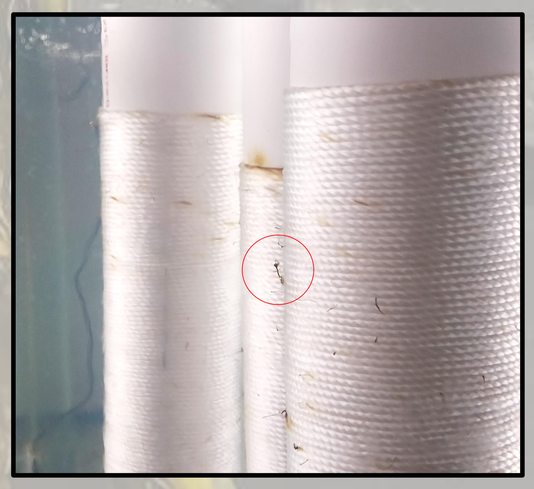

**Figure 5. Kelp Growth**

## IN THE KITCHEN

While the kelp was growing our team experimented with a few kelp recipes, all based off the idea of creating a kelp product similar to Brad's Raw Kale. We wanted to use as few additives as possible, and keep kelp's natural vitamins and minerals intact. We do this by baking kelp after going through a very unique series of hydrating and rehydrating dried kelp (purchased from **Maine Seaweed**).

**Figure 5. Raw Kelp, Kelpÿ Logo, Cooked Kelp**

## CONNECTIONS

Throughout the summer, we visited kelp farms, cheese farms, and restaurants. We met with restauranteurs, chefs, and people involved in the food business. After all these experiments, we were surprised that people in the industry fully supported our idea. This is interesting because the food industry is known to already be saturated; but from our perspective we aren't adding to a bloated industry-we're changing it by creating a product that has a net *positive* effect on our natural environment.

## WHAT WE LEARNED FROM MOUNTAINTOP

"I've learned that creativity can be accomplished through logical processes, and isn't always brought about by spontaneity of thought, or serendipity." – Will Kuehne

"I learned that botany in the ocean is a lot harder than botany on land!" – Carlen Donahue

"The Mountaintop Experience taught me a lot about the importance of combining academia and creativity" –Carolyn Koch

"I learned hot to cut wires, split wires and use wire screws to make light fixtures" – Kyle Conway

## FUTURE WORK

Kelpÿ continues to gain publicity, but we always want more. We will be participating in competitions, events that sponsor entrepreneurship, and continue to grow our presence online. In addition, we will continue to improve our product by gaining insights from chefs, and people in the food industry.

## REFERENCES

**(1) Alpern, Ethan. "USGS Newsroom." USGS Release: Tracking the Nitrate Pulse to the Gulf of Mexico (11/4/2014 11:36:38 AM). USGS, n.d. Web. 06 Sept. 2015. <http://www.usgs.gov/newsroom/article.asp?ID=4046&from=rss#.VezwcdNViko>.**

**(2)Fram, Jonathan, and Mark Brzezinski. "Physical Pathways and Utilization of Nitrate Supply to the Giant Kelp, Macrocystis Pyrifera." Wiley. Marine Science Institute, n.d. Web.<http%3A%2F%2Fonlinelibrary.wiley.com%2Fstore%2F10.4319%2Flo.2008.53.4.1589%2Fasset%2Flno20085341589.pdf%3Bjsessionid%3DAA50664CC1FAA606D2712015BAA58803.f03t04%3Fv%3D1%26t%3Die9abte7%26s%3D32bf9f931805c444056b36ccc8b4101fc716b1fd>.**

**Figure 1. USA Street Blog. Sept 7, 2015.< http://usa.streetsblog.org/>.**

**Figure 2. Katie Flavin, Nick Flavin, Bill Flahive. (2013) Kelp Frming Manual. Maine: Ocean's Approved. 2013**

**Figure 3. Katie Flavin, Nick Flavin, Bill Flahive. (2013) Kelp Frming Manual. Maine: Ocean's Approved. 2013**