The Urchin Merchants

Where saving the oceans is our business

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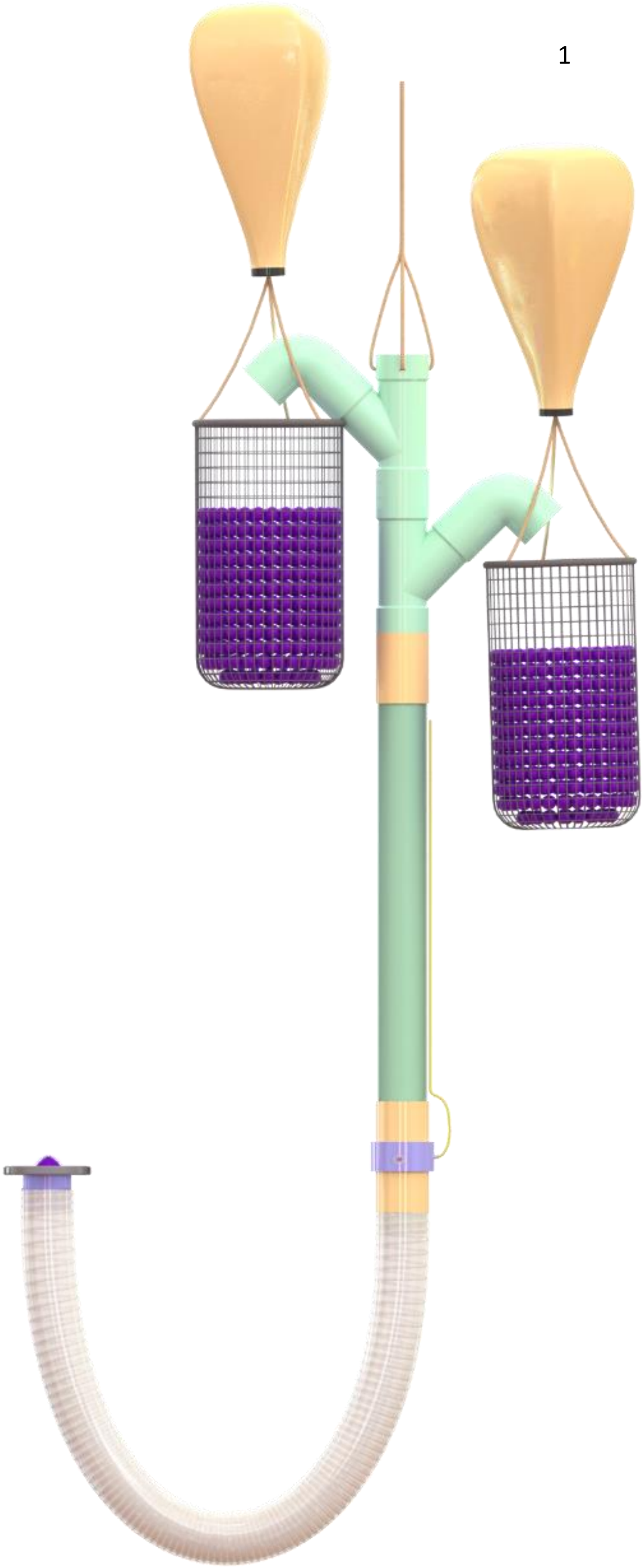


Background

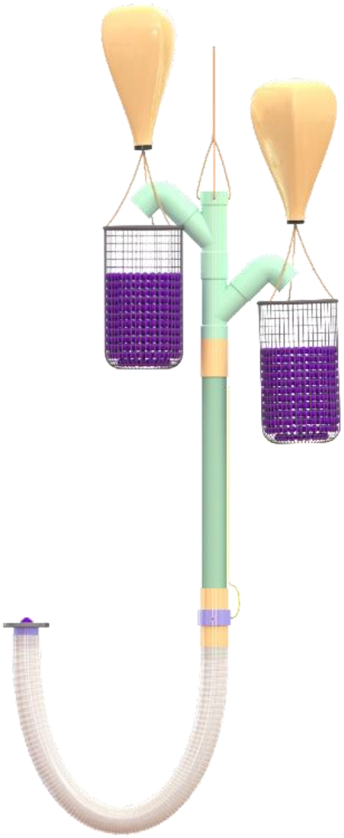
Kelp forests are not only beautiful and full of diverse aquatic life, but they also sequester up to 20 times more carbon per acre than land forests. Yet, what if all those kelp forests disappeared? What if they already have?

Purple sea urchins have destroyed over 95% of kelp forests of the coast of California alone. They are a serious issue is Japan, Norway, and New Zealand to name just a few of the global locations. Due to a combination of factors – including a disease spreading among predators and a hugely successful reproductive year – the urchin population skyrocketed. Once the ecosystem was unbalanced, the urchins devastated the kelp by eating away at the base. With the kelp dead, no other creatures could survive. This created urchin barrens, where the urchins live in zombie states for over 40 years, eating anything that lands in the area (like kelp seeds that might otherwise repopulate the area).

However, the situation is not without hope. It has been proven that by removing the purple urchins, decreasing their population from up to 150 per square meter back down to a healthy 2, the kelp forests can regrow in as little as five years.

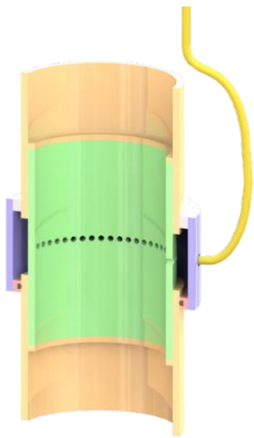
Our urchin vacuum efficiently removes these urchins: not only allowing the much needed kelp forests to regrow, but also providing the user with a profitable byproduct (large and small sea urchins perfect to eat or grind up into fertilizer). The device is sturdy, easy to use and maintain, energy efficient, and modular. The device and our team have also been featured in an article on Phys Org and the Mechanical Engineering department website.

The Design



Our team created an underwater sorting collection vacuum to aid in the removal of purple sea urchins, as well as ocean pollution and other invasive species. The team designed the underwater vacuum with simple assembly and manufacturing methods in mind to reduce the overall device cost and make the device more accessible to kelp restoration agencies. Since divers will operate the underwater vacuum in ocean water that has high concentrations of salt, the team designed the underwater vacuum to be composed of PVC and PLA plastic parts because those components don't degrade or corrode in high salinity. This greatly increases the lifetime of the underwater vacuum.

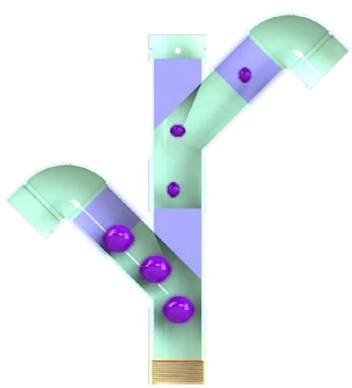
This device has 4 subsystems: a custom aeration nozzle, a sorting system, a collection system, and a user interface system.

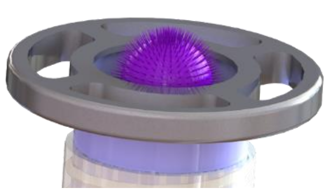


The custom aeration nozzle went through multiple testing iterations in order to determine the best inlet hole geometry as well as the configurations and order of the holes.

The sorting system is composed of two removable inserts that sort the urchins into big and small. The big ones can be farmed while the small ones can be used as fertilizer.

The collection system is comprised of two 50-gallon mesh bags that can hold approximately 1600 urchins each. These bags are at the outlets of the sorting tubes, the big urchins go into one bag and the small urchins into another. The bags can be quickly and easily switched once they reach capacity. The collection systems have flotation devices attached to the top of them, so that when the collection bag is full and ready to be collected, the dive floatation device can be inflated, and it will bring the collection system to the surface.

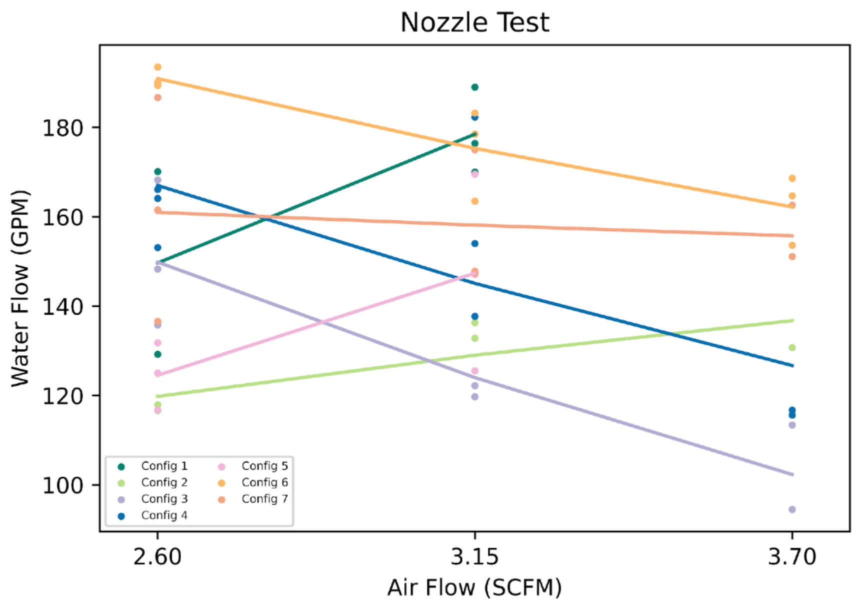


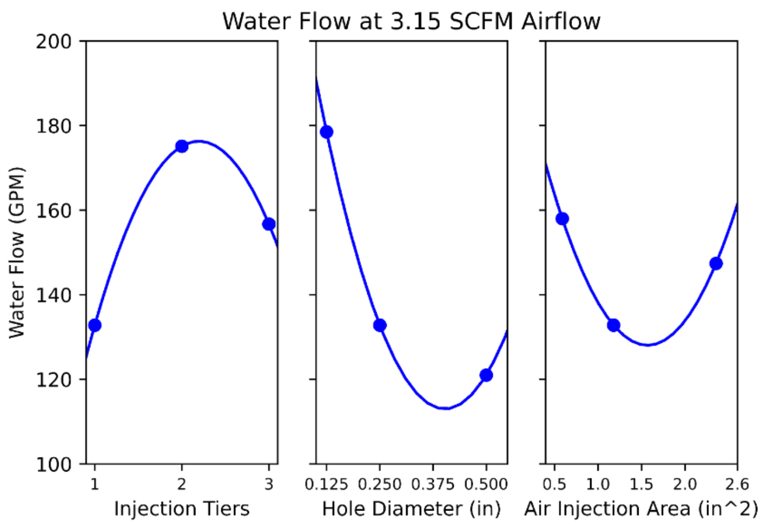


Finally, our system has an ergonomic friendly user interface system. This consists of a flexible suction tube with a handle at the end that was designed to be compatible with the diving gloves that urchin collectors wear. This tube has a sweeping radius of about 8 feet and can be easily collapsed down for transportation.

Testing Results

The project is an underwater collection device that acts as an airlift using compressed air to power the pumping mechanism. The system was designed to collect primarily stationary objects at a high rate with little to no damage to the surrounding environment. The goal of our testing was to maximize the efficiency of the pumping mechanism by testing different nozzle configurations at different compressed air flow rates and recording flow rate through the airlift. Our most effective nozzle could produce 190 GPM of flow through our airlift for just 2.6 SCMF of air.





The sorting system’s accuracy in separating objects of diameter larger or smaller than 1.6 inches also was tested and found to be 96.3% accurate. This is after a redesign that allowed for minimal blockage of the main tube by our sorting inserts compared to previous designs.

The team also set out to confirm the addition of a sorting system along with 10 feet of flexible tubing will not cause pressure losses significant enough to stop the system from operating at a reasonable flow rate. In testing the addition of our 2 subsystems was found to only cause a 5% decrease in flow rate in our system.

The Team

Our team is composed of 6 senior mechanical engineering students who have a strong passion for the environment. With 10+ years of engineering industry experience, as well as 5+ years of management experience, the team has all the necessary skills to bring this project to fruition. Additionally, we had the privilege of being mentored by the former chief propulsions engineer at Boeing as well as the Sr. Engineering Account Manager at Intertech Plastics Inc. With this, there is no team better equipped for fulfilling our mission than us.

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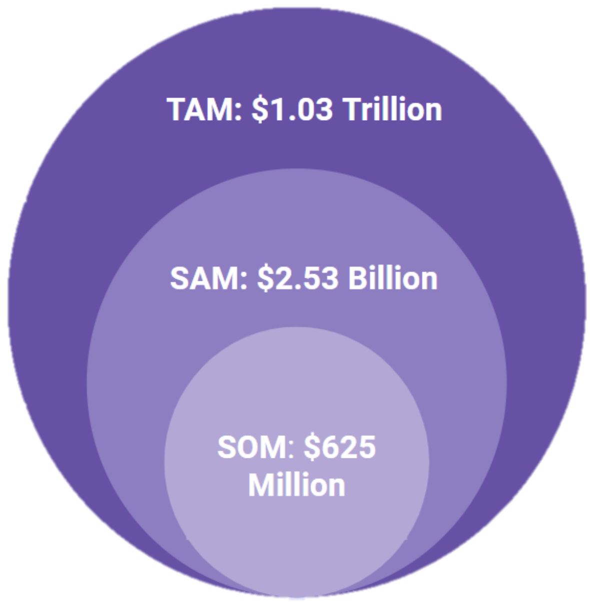
Next Steps

With current methods, it costs around $324,000 to clear a single acre of an urchin barren. With our device, that has a 6 times higher collection rate, it will only cost $54,000. The device is expected to cost roughly $220 dollars for parts.

As for what we can do with the device, the team has analyzed the markets out there and realized the Urchin Market alone is $1.03 trillion, with $2.53 billion focused just on the coastline of Northern California.

With this being said, the team has come to the unanimous decision to make the device free to the public. We believe in order to make most out of our device and make the largest impact, access to our device should be unimpeded. We want the organizations we talked with to be able to build this device for cost of parts alone. This how we are going to save the oceans.



The team also plans to send our current prototype to The Bay Foundation, as their user input has been instrumental in the design of our device.