From Shoreline to Seafloor:

Turning Beach Plastics into Tools for Coral Reef Conservation

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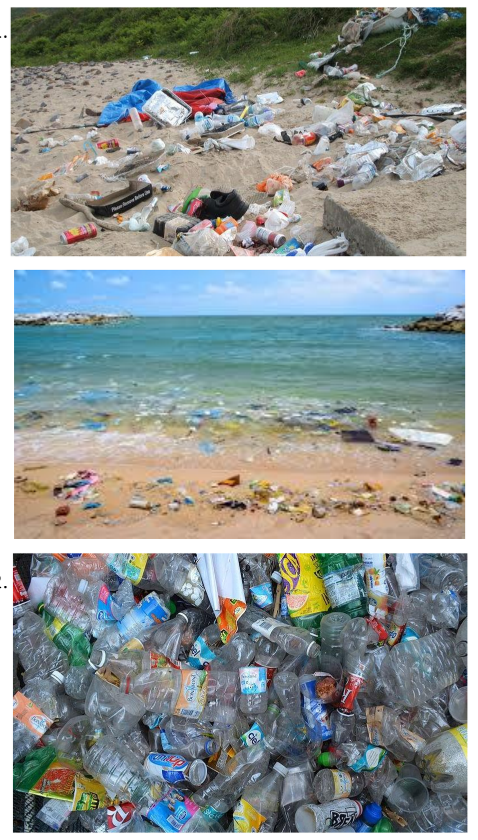
Abstract

This project integrates coastal cleanup with marine conservation by converting plastic waste into functional tools for ocean research and conservation. Using our custom-built device, the **PETamentor**, we transform PET bottles collected from beaches into 3D-printable filament. This recycled filament is used to build components for an underwater Remotely Operated Vehicle (ROV) designed to monitor coral reefs and collect biological samples. Our goal was to demonstrate that plastic waste could be repurposed into high-quality PETG filament suitable for marine research applications. We successfully developed a working system that not only supports coral health monitoring but also enables the creation of 3D-printed artificial reef scaffolds, which can help restore damaged habitats. By linking environmental cleanup with reef restoration, our project offers a sustainable, scalable solution to two major environmental challenges: plastic pollution and coral reef decline. It showcases how recycled materials can power scientific innovation and ecological recovery.

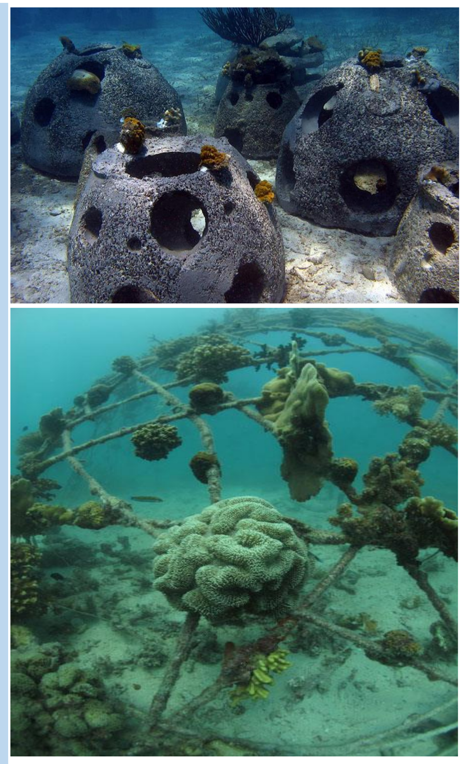
Background & Motivation



We chose this project because we were passionate about solving two urgent problems: plastic pollution in our coastal environments and the threats facing coral reefs due to climate change. Plastic waste, especially single-use bottles, frequently ends up on beaches or in the ocean where it breaks down into harmful microplastics. At the same time, coral reefs — vital ecosystems that support marine life — are under increasing stress from warming waters, acidification, and pollution.

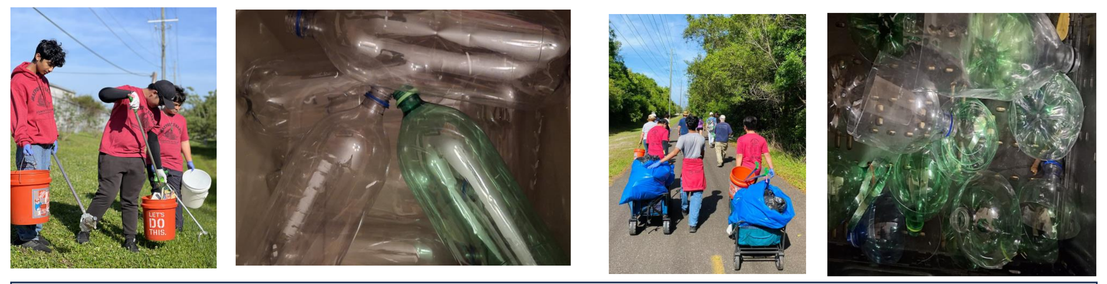
Project Goal & Solution

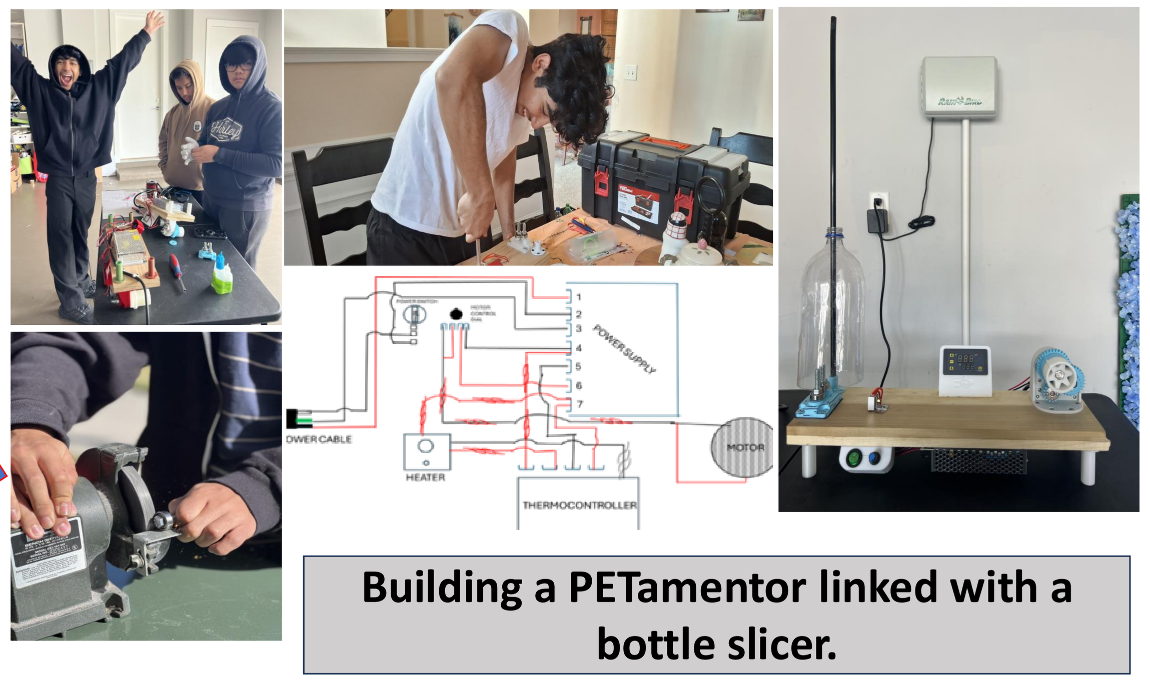
We aimed to turn plastic waste into tools for reef conservation. Using our PETamentor, we converted beach-collected PET bottles into 3D-printable filament using our custom built PETamentor. The filament was used to build parts for an underwater ROV that monitors coral reefs and collects samples. It can also be used to create reef scaffolds that provide habitat for coral growth, linking cleanup with restoration through sustainable, recycled materials.



Our Path From Problem to Solution

Collection of discarded PET plastic bottles from Beach and Coastal waterways clean up. Bottles were cleaned and dried before processing.

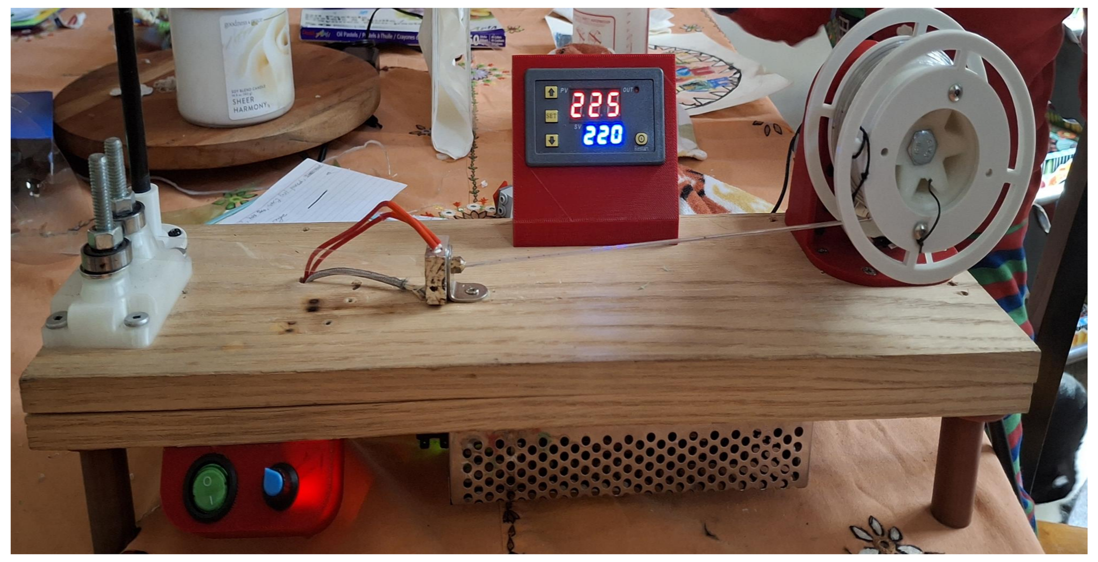




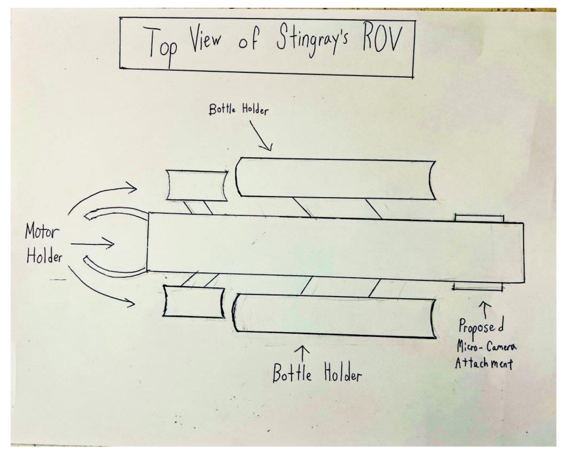
Building a PETamentor linked with a bottle slicer.

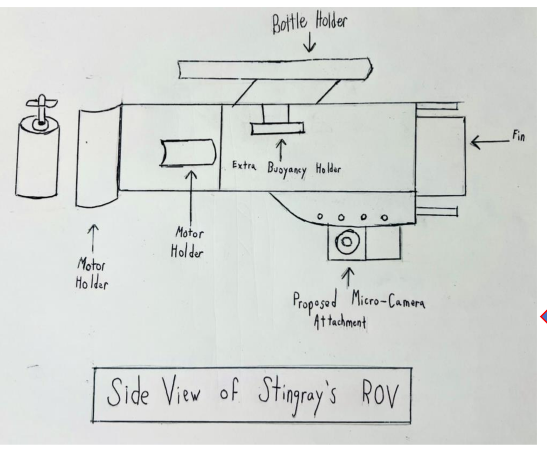
Testing and troubleshooting the PETamentor

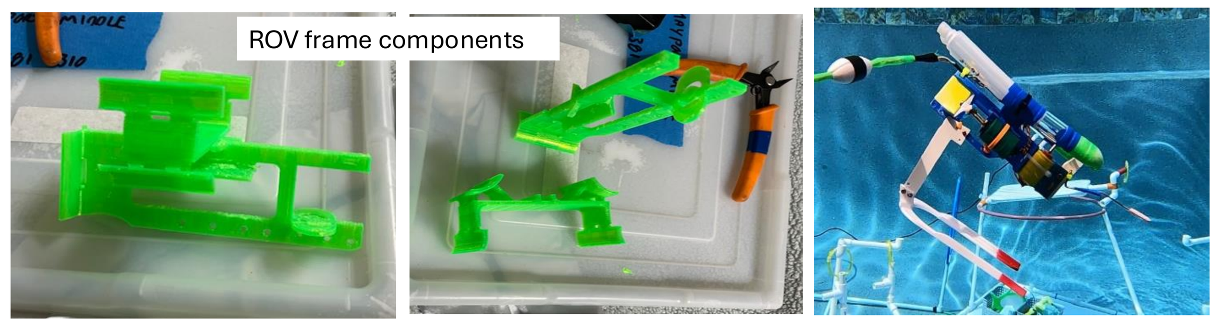
Extruder speed | **Plastic ribbon thickness** | **Temperature for filament** | **Motor speed**



Building parts, coral modular scaffolding and ROV from recycled filament

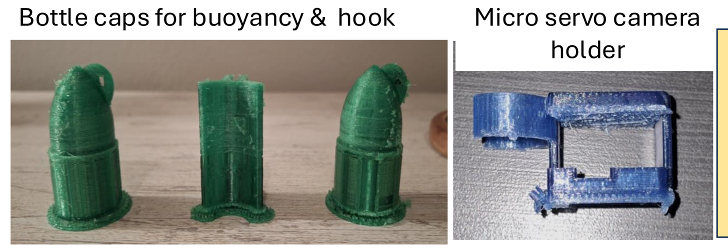






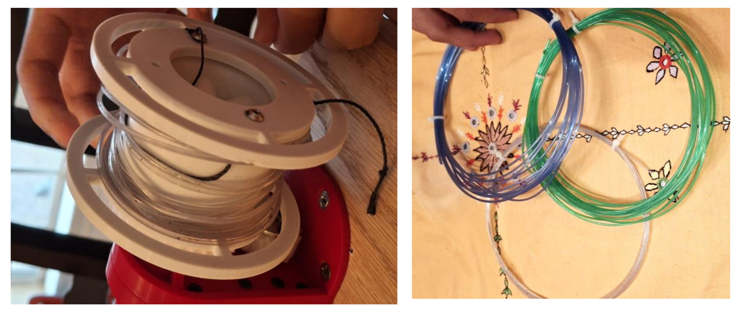
Bottle caps for buoyancy & hook

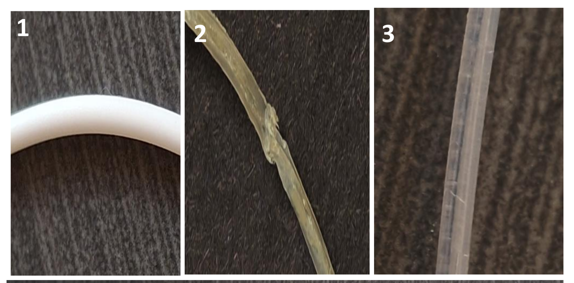
Micro servo camera holder

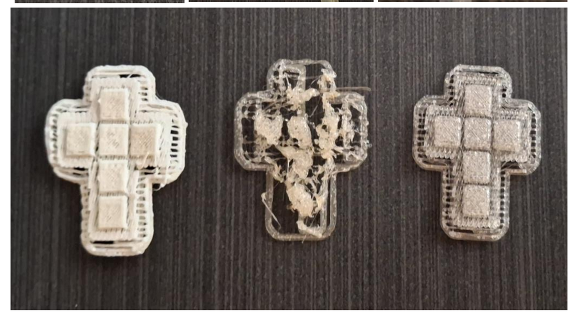


Would you like to make your own filament? Need help? Shoot us an email: **Mayportsharksroboticsclub@gmail.com**.

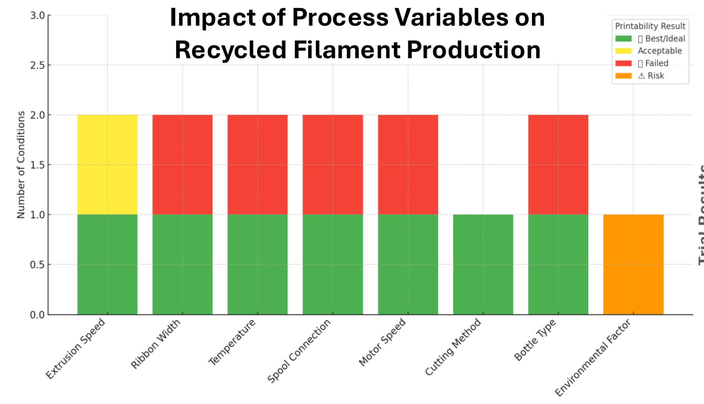
Testing the recycled 3D-filament

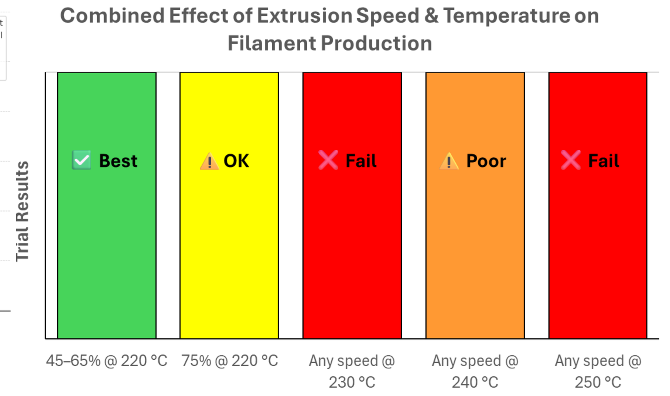






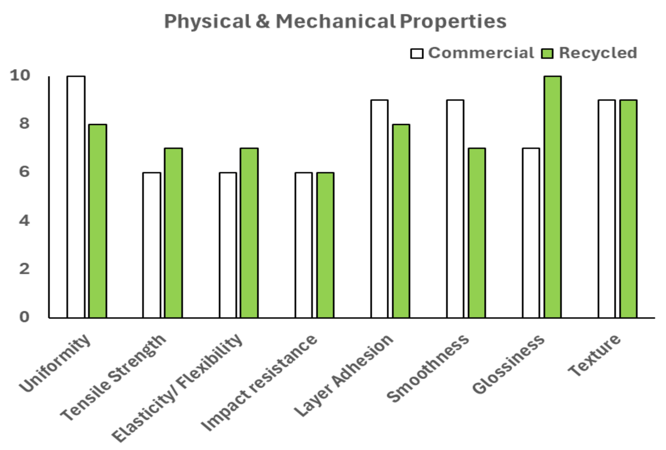
1. Commercial filament
2. Recycled filament (240 °C)
3. Recycled filament (220 °C)

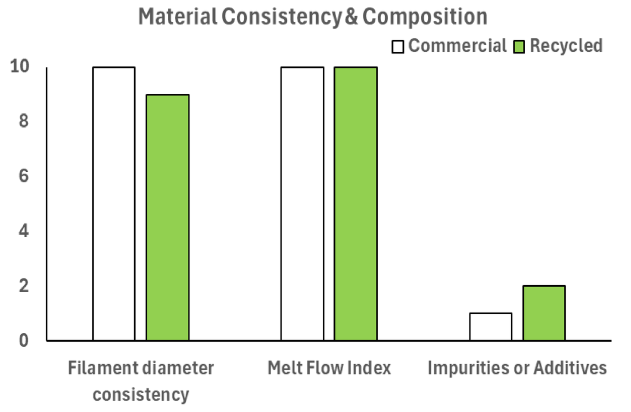


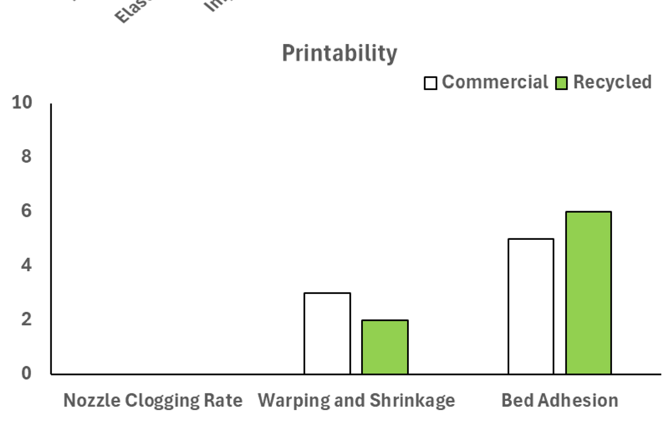


IDEAL CONDITIONS

Trials show 220 °C at 45–65% extrusion speed using a 10 mm plastic bottle ribbon yields the smoothest, most reliable filament from recycled bottles.







Next Steps

- **Iterative Prototyping Is Key:** Design adjustments were needed as underwater conditions exposed flaws in early ROV models. Protecting electronic components and maintaining compactness required constant tweaks.
- **Sustainability Can Be Scalable:** With consistent collection efforts and PETamentor optimization, this method could be replicated for larger conservation missions, especially in remote or low-resource coastal areas.
- **Community Engagement Matters:** Collaborations with beach cleanup groups not only provided raw materials but also built public awareness about plastic pollution and coral conservation.

- Test ROV for maneuverability, video clarity, and durability
- Evaluate reef scaffolds for coral attachment and growth
- Optimize filament output for reliable 3D printing
- Refine ROV design for portability
- Explore tool printing for disaster relief and healthcare

Conclusion

We aimed to reduce plastic waste and production costs by converting litter into PETG filament. Using the PETamentor, we turned beach-collected bottles into 3D printing filament, which we used to build parts for a compact, reef-safe ROV. Despite technical challenges, we successfully produced usable filament and demonstrated a closed-loop system for marine restoration. The project highlights how teamwork and innovative engineering can turn waste into tools for conservation.

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Acknowledgements

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- **https://petamentor2.com** for technical guidance