

Oyster River Ecology

Oyster Rag Pot Fabrication Guide



Prepared for:
Anyone Who Will Use It

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Purpose:
This guide is provided to show
other organizations and
individuals how to make
Oyster Rag Pots.



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Introduction

Oyster Rag Pots (ORPs) were developed by Oyster River Ecology to address primary limitations to large scale oyster habitat restoration in cultch-limited, subtidal environments with soft sediments. Traditional restoration materials, such as oyster shell, are simply not available in the quantities needed to restore habitat at desired scales in many areas. Alternative substrates, including limestone and other natural rock, remain cost prohibitive for projects spanning tens or hundreds of acres, while engineered reef modules are often substantially more expensive.

The objective was to develop a restoration system that could be produced at a lower cost than natural rock while maintaining the characteristics necessary for successful reef development. ORPs were specifically designed to address cost and scalability while maximizing vertical surface area for oyster larval attachment and growth, reducing exposure to benthic predators, and providing a stable structure that can be installed directly into unconsolidated sediments. By maximizing settlement surface area relative to the amount of material required, ORPs substantially reduce material costs while increasing the habitat available for oyster recruitment.

While ORPs have proven highly successful on our restoration projects, it is important to recognize that the restoration technique is only part of the equation. Successful oyster restoration depends just as much on understanding the ecosystem and selecting locations where oysters can thrive. We place significant emphasis on identifying sites with appropriate salinity conditions, food availability, hydrology, sediment characteristics, and predation pressure before restoration begins. The best restoration material in the world will not succeed if it is installed in the wrong location.

With a single cement mixer and a two-person production crew, approximately 500 ORPs can typically be manufactured during an eight-hour workday. This includes preparing materials, producing ORPs, packing units fabricated the previous day, and cleaning the production area at the end of the day. As with any new production process, there remains considerable opportunity to improve efficiency through continued refinement and automation.

Because the manufacturing process is simple and requires minimal specialized skills, ORP production also provides an excellent opportunity to engage volunteers in meaningful habitat restoration. Community members become active participants in creating the restoration materials that will ultimately become living oyster reefs, strengthening both restoration capacity and long-term community stewardship.

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The techniques described in this guide are being shared openly in the hope that they will help advance large scale, cost-effective oyster restoration wherever they are applicable. Our goal is not simply to restore one area, but to provide practical tools that enable others to restore many.

The result is a simple, scalable, and cost-effective restoration technique that makes large scale oyster reef restoration financially achievable in systems where conventional approaches are constrained by material availability, installation costs, and project scale.

Materials

The following materials have been successfully used by Oyster River Ecology for ORP fabrication. Similar materials may also work but should be tested before being incorporated into full-scale production.

- **Cement**

Titan Portland-Limestone Cement, Type II

<https://www.lowes.com/pd/Titan-Florida-94-lb-TITAN-PORTLAND-TYPE-1L/5014196535>

- **Cotton Rags**

12-inch by 14-inch cotton rags

<https://a.co/d/0c8zXK1G>

- **Wooden Spacers**

4-inch by 4-inch by 1/8-inch wooden crafting squares

<https://a.co/d/0aQEEegQ>

Spacer holes must be drilled before ORP production begins.

- **Circle-Top Pins**

12-inch galvanized circle-top pins, 8 gauge

<https://sandbaggy.com/products/12-in-circle-top-pins>

Supplies and Personal Protective Equipment

The following supplies and personal protective equipment are recommended for ORP production:

- Dust masks

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- Reusable gloves
- Disposable gloves
- Safety goggles
- Aprons
- Tarps in various sizes for floor protection
- Brooms and dustpans
- Trash bags and waste containers
- Rubber mallets for removing dried cement from mixing tubs

Recommended dust masks:

<https://a.co/d/00GHRZX6>

Recommended reusable gloves:

<https://a.co/d/02yQjtkJ>

Recommended disposable gloves:

<https://a.co/d/06EjlEpt>

Equipment

The following equipment is recommended for establishing an ORP production line.

- **Cement Mixer**

A cement mixer with a plastic drum is recommended. A plastic drum makes it easier to remove dried cement than a steel drum.

<https://www.lowes.com/pd/Kobalt-4-cu-ft-0-5-HP-Cement-Mixer/3591096>

- **Cement Scoops**

Large, heavy-duty scoops are used to transfer and measure dry cement.

Recommended 82-ounce scoop:

<https://a.co/d/088ejYu1>

- **Mixing Tubs**

Mixing tubs are used to receive coated rags and hold additional cement slurry during assembly.

<https://www.homedepot.com/p/Small-Mixing-Tub-A-41/318924439>

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- **Storage Totes**

Twenty-seven-gallon storage totes are suitable for storing and transporting cured ORPs.

<https://www.homedepot.com/p/HDX-27-Gal-Tough-Storage-Tote-in-Black-and-Yellow-999-27G-HDX/327528802>

- **Spring Clamps**

Spring clamps are used to suspend wet ORPs from drying racks.

<https://a.co/d/09OAN4Ke>

- **Drying Racks**

Drying racks support the ORPs during the curing process.

<https://a.co/d/0auOHQ8w>

- **Preparation Tables**

Preparation tables provide work surfaces for assembling and finishing ORPs.

<https://a.co/d/09mDUO4t>

- **Hydraulic Lift Cart**

A hydraulic lift cart is helpful for moving cement bags, storage totes, and other heavy materials around the production area.

<https://www.harborfreight.com/1000-lb-capacity-hydraulic-table-cart-70725.html>

- **Storage Shelving**

Heavy-duty shelving should be used to organize cement, rags, spacers, pins, personal protective equipment, and other production supplies.

Work Area Setup

Before beginning ORP production, take the time to organize the work area for safety and efficiency. A well-planned workspace will improve production rates, reduce cleanup time, and help maintain a consistent workflow throughout the day.

Begin by laying tarps on the floor to capture cement drips and spills. Tarps should be placed beneath the preparation tables, drying racks, cement mixer, and other areas where wet or dry cement will be handled.

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Before mixing any cement, conduct a dry run of the entire production process. Walk through each step to ensure that materials, tools, workstations, and drying racks are arranged in a logical sequence. Workers should be able to move coated rags from the cement mixer to the assembly tables and then to the drying racks without unnecessary lifting, crossing work areas, or creating congestion.

For a basic production line capable of producing approximately 500 ORPs per day, Oyster River Ecology recommends the following minimum setup:

- 10 drying racks
- 2 preparation tables
- 540 spring clamps
- 4 mixing tubs
- 2 cement scoops
- 1 cement mixer
- 1 hydraulic lift cart

Each ORP requires approximately 1.4 pounds of Portland cement mixture. Portland cement is commonly supplied in 94-pound bags, with each bag producing approximately 67 ORPs. A production goal of 500 ORPs per day will therefore require approximately 7.5 bags, or 705 pounds, of cement.

These calculations are approximate. Actual cement use may vary depending on mixture consistency, fabric absorbency, coating thickness, waste, temperature, humidity, and operator technique.

Investing time to properly organize the production area before fabrication begins will improve efficiency, reduce cleanup time, and help maintain a smooth workflow throughout the day.

ORP Fabrication Procedure

1. Put on Personal Protective Equipment

Before handling dry or wet cement, all participants should put on the appropriate personal protective equipment. This should include, at minimum:

- Dust mask

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- Eye protection
- Gloves
- Apron or other protective clothing

Avoid breathing cement dust and prevent wet cement from contacting exposed skin or eyes.

2. Add Water to the Cement Mixer

Pour 350 fluid ounces, approximately 2.75 gallons, of water into the cement mixer.

Turn on the mixer and allow the drum to begin rotating before adding cement.

3. Add Portland Cement

Slowly add approximately 45 pounds of Portland cement to the water while the mixer is rotating.

Using a scoop that holds approximately five pounds, this will require about eight scoops of cement.

Add the cement gradually to reduce dust and help prevent clumping.

4. Add the Cotton Rags

For the initial batch, add 20 cotton rags to the mixer one at a time while the drum continues to rotate.

Adding the rags individually helps prevent them from bunching together and allows each rag to become fully coated.

The first batch should produce a surplus of cement slurry that can be used later during ORP assembly.

5. Allow the Rags to Become Fully Coated

Allow the rags to tumble in the cement mixture until they are completely saturated and the original fabric color is no longer visible.

Inspect the rags carefully. All surfaces should be thoroughly coated, with no large areas of exposed fabric remaining.

6. Transfer the Coated Rags

Transfer the coated rags from the cement mixer into a mixing tub.

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Transfer a portion of the excess cement slurry into the same tub for hand application during assembly as needed.

Keep the coated rags together and avoid allowing them to dry before assembly.

7. Prepare the Pin and Spacer

Slide a pre-drilled wooden spacer onto a galvanized circle-top pin.

The spacer hole should fit securely around the pin while still allowing the spacer to be moved into the correct position.

8. Position the Rag

Remove one coated rag from the mixing tub and spread it flat across the preparation table.

Center the pointed end of the pin over the middle of the coated rag. Apply downward pressure to push the pin through the center of the rag and through the pre-drilled spacer.

9. Secure the Spacer

Place one hand on the circular top of the pin while using your fingers to hold the wooden spacer in position.

Maintain control of the pin and spacer throughout the assembly process to prevent the spacer from shifting out of place.

10. Form the ORP

Using your other hand, gently pull the coated rag upward around the pin.

Center the rag over the spacer and carefully invert the assembly while holding the pointed end of the pin. The coated fabric should hang downward over the spacer, creating the characteristic pot-shaped form.

11. Apply Additional Cement Slurry

Apply additional cement slurry around the location where the pin passes through the spacer.

Use the additional slurry to reinforce this connection point and cover any thin areas or exposed fabric. The entire rag should have a consistent coating, but excessive slurry should be avoided because it adds unnecessary weight and may drip during curing.

12. Transfer the ORP to the Drying Rack

Carefully move the completed wet ORP to a drying rack.

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Suspend the ORP from the rack using a spring clamp. Make sure the clamp is securely attached and the ORP hangs freely without touching the floor, adjacent ORPs, or other surfaces.

13. Allow the ORP to Cure

Allow the ORP to cure for approximately 24 hours.

Actual curing time may vary depending on temperature, humidity, airflow, coating thickness, and the cement product being used. The ORP should be sufficiently hardened before it is removed from the drying rack or placed into storage.

14. Pack and Store the Cured ORPs

Once the ORPs have cured, remove them carefully from the drying racks.

Place the cured ORPs into storage totes. Oyster River Ecology typically stores 15 ORPs in each 27-gallon tote.

Avoid dropping, throwing, or tightly compressing newly cured ORPs. Cement will continue gaining strength after the initial curing period.

15. Repeat and Adjust the Process

Repeat the fabrication process, adjusting the number of rags or the amount of cement mixture as necessary to maintain an appropriate amount of excess slurry.

The goal is to produce enough additional slurry for reinforcing connection points and covering thin areas without creating excessive waste.

16. Make Small Mixture Adjustments as Needed

Adjust the water content as necessary to maintain a thick, workable cement slurry.

Mixture consistency may vary between cement bags and in response to temperature and humidity. Make only small adjustments. Adding too much water can create a thin mixture that runs off the fabric, produces an inconsistent coating, and may reduce the strength of the finished ORP.

The slurry should thoroughly coat and penetrate the fabric without excessive runoff.

Production Notes

With a single cement mixer and a two-person crew, approximately 500 ORPs can typically be produced during an eight-hour workday.

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This production rate includes:

- Preparing the work area
- Loading and mixing materials
- Coating the rags
- Assembling the ORPs
- Hanging ORPs on drying racks
- Packing ORPs made the previous day
- Cleaning tools and work areas

Production rates will vary based on worker experience, workspace design, availability of materials, environmental conditions, and the number of tasks performed during the workday.

The ORP process is still relatively new, and there is considerable opportunity for continued refinement and improvement. Organizations adopting this process are encouraged to carefully document changes to materials, mixture ratios, production methods, and resulting ORP performance.

Quality Control

Each completed ORP should be inspected before it is transferred to the drying rack.

Confirm that:

- The fabric is fully saturated with cement.
- No large areas of exposed fabric remain.
- The pin passes through the approximate center of the rag.
- The wooden spacer is centered and properly positioned.
- The rag hangs evenly around the spacer.
- Additional slurry has been applied around the pin and spacer connection.
- Thin areas have been reinforced.
- The ORP hangs freely without contacting nearby objects.

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- The spring clamp is securely attached.
- The finished ORP has a consistent shape and coating.

Cleaning and End-of-Day Procedures

Clean the work area at the end of each production day before cement fully hardens on tools and equipment.

Remove wet cement residue from:

- Mixing tubs
- Preparation tables
- Scoops
- Cement mixer
- Gloves and reusable tools
- Lift cart
- Floor tarps

Once cement dries inside mixing tubs, gently flex the tubs or use a rubber mallet to loosen the hardened material. Avoid damaging plastic tools or equipment during cleaning.

Sweep and properly dispose of dry cement dust and hardened waste. Do not wash cement slurry into storm drains, waterways, landscaped areas, or other locations where it could enter the environment.

Return unused materials and personal protective equipment to designated storage areas. Confirm that all curing ORPs are securely suspended and that the drying racks are stable before leaving the production area.

ORPs Made with CSA Cement

Oyster Rag Pots can also be fabricated using calcium sulfoaluminate cement, commonly referred to as CSA cement.

Although CSA cement is significantly more expensive than Portland cement and has a much shorter working time, it offers several advantages for certain applications.

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The primary benefit of CSA cement is its rapid strength gain and shortened curing period. This makes it well suited for mobile volunteer events, demonstrations, or other situations where a 24-hour curing period is not practical.

CSA cement is also formulated for thin-section applications and produces a harder, denser substrate. This may make it more desirable for ORPs installed in higher energy environments, such as intertidal shorelines or areas exposed to greater wave action and abrasion.

The ORP assembly process is the same as the process used with Portland cement. However, CSA cement should be mixed by hand in small batches rather than prepared in a cement mixer.

A typical CSA cement batch consists of:

- Approximately 1.2 pounds of CSA cement
- Approximately 5 fluid ounces of water
- Enough mixture to produce up to five ORPs

Because CSA cement begins to set very quickly, only prepare the amount that can be used immediately. Once mixed, the material rapidly becomes stiff and difficult to apply properly to the fabric.

Small batches are essential. Do not attempt to prepare a large volume in advance.

Oyster River Ecology has used Rapid Set Cement All for CSA cement ORP production:

<https://www.homedepot.com/p/Rapid-Set-55-lbs-Cement-All-Multi-Purpose-Construction-Material-Non-Shrink-Grout-02010055/202188447>

Important Considerations for ORP Application

We have had considerable success with ORPs on our site in the Manatee River. In this location we install ORPs at 1 foot centers and are seeing near coalesce of oyster growth within on year of installation on ORPs installed in the spring. ORPs are a restoration tool, not a substitute for proper site evaluation.

Successful oyster reef restoration depends on selecting locations with environmental conditions that support oyster recruitment, survival, growth, and long-term reef development. Before installing ORPs, practitioners should develop a clear understanding of the restoration system and the factors that have historically limited oyster populations.

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Important considerations may include:

- Salinity conditions
- Freshwater inflows
- Food availability
- Dissolved oxygen
- Water depth
- Tidal exposure
- Sediment characteristics
- Hydrodynamic energy
- Larval oyster availability
- Existing oyster growth
- Predation pressure
- Navigation and public access
- Permitting requirements

ORPs have been highly successful in Oyster River Ecology's restoration projects, but that success is not solely the result of the ORP design. It is also the result of carefully identifying locations where oysters are likely to thrive.

The best restoration structure will not produce a successful reef if it is installed in an unsuitable location.

Other Applications for ORPs

Although Oyster River Ecology has primarily used Oyster Rag Pots (ORPs) in areas with abundant natural oyster recruitment, we have received considerable interest from practitioners working in systems where spat availability is the primary limiting factor.

Researchers at Roger Williams University in Bristol, Rhode Island, are currently evaluating the use of hatchery-produced spat on ORPs. If you are interested in this application, please contact Damon Moore or Abbey Kuhn at Oyster River Ecology, and we would be happy to connect you with the appropriate researchers at Roger Williams University.

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We have also had preliminary discussions with staff at Mote Marine Laboratory regarding the potential use of ORPs as a substrate for coral restoration. While these conversations are promising, they remain in the very early stages, and no field trials have been conducted as of the writing of this document.

We believe the ORP concept has the potential to extend well beyond oyster restoration. With modifications to the design, such as increasing thickness, using calcium sulfoaluminate (CSA) cement, and reducing spacing between units, ORPs may provide a cost-effective solution for shoreline stabilization and restoration in higher-energy environments. We also see potential applications in sponge restoration, hardbottom habitat restoration, and other marine ecosystem restoration efforts.

Exploring these possibilities is one of the primary reasons we are openly sharing this technique. We hope researchers, restoration practitioners, and conservation organizations will continue testing, refining, and adapting the ORP concept to address a wide variety of coastal restoration challenges.

Volunteer Engagement

The relative simplicity of ORP production makes it an effective way to involve volunteers directly in habitat restoration.

Volunteers can participate in several stages of the process, including:

- Preparing spacers and pins
- Organizing materials
- Assisting with rag coating
- Assembling ORPs
- Applying additional cement slurry
- Hanging ORPs on drying racks
- Packing cured ORPs
- Cleaning and organizing the work area

All volunteers should receive appropriate safety instructions and direct supervision before participating. Personal protective equipment should be required whenever participants are working around dry or wet cement.

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Volunteer participation provides meaningful assistance with production while also allowing community members to directly contribute to the creation of living oyster reefs.

Sharing and Continued Improvement

The ORP fabrication process described in this guide is being shared to help advance large scale, cost-effective oyster restoration wherever the method may be useful.

This process is still evolving. Continued testing, documentation, and refinement may improve production efficiency, material performance, durability, volunteer participation, and field installation.

Organizations using or adapting the method are encouraged to document:

- Cement products used
- Water-to-cement ratios
- Fabric types and dimensions
- Spacer materials and dimensions
- Pin materials and dimensions
- Production rates
- Curing times
- Installation methods
- Recruitment rates
- Oyster survival and growth
- Long-term reef development

Sharing these findings can help improve the technique and expand its usefulness across different restoration systems.

Oyster Rag Pot Installation

The installation of Oyster Rag Pots (ORPs) will vary from site to site depending on water depth, tides, staffing levels, project goals, sediment type, access, available equipment, weather conditions, and the scale of the restoration project. There is no single "right" way

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to install ORPs. Successful installation is largely a matter of understanding the site, planning the logistics, and adapting your approach to local conditions.

As of the writing of this document, Oyster River Ecology has installed more than 50,000 Oyster Rag Pots across several restoration sites. Along the way, we have encountered and solved a wide variety of logistical challenges, from transporting thousands of ORPs to remote locations to developing efficient methods for staging, deploying, and installing them at meaningful scales. Many of the techniques we use today were developed through trial and error in the field and have significantly improved both installation efficiency and volunteer participation.

Because every restoration site presents unique challenges, we encourage practitioners to adapt these methods to fit their local conditions. If you have questions about installation logistics, site planning, equipment, or deployment strategies, please don't hesitate to reach out. We are always happy to share what we have learned.

Better yet, come join us for an installation day. There is no substitute for seeing the process firsthand. If you're willing to spend a day helping us install ORPs, we'll gladly share our methods, explain the reasoning behind them, and answer any questions along the way. One day in the field is often worth far more than pages of written instructions.

Acknowledgments

This work would not have been possible without the dedication, creativity, and hard work of many people.

A special thank you to Abbey Kuhn, who has played an instrumental role in developing and refining Oyster Rag Pots into what they are today. From the earliest prototypes made at the end of a driveway to installing the first dedicated ORP test plot, to countless days spent loading and unloading the entire production operation from “Oliver the Oyster Trailer” under the hot Florida sun, Abbey has been there every step of the way. Thank you, Bo.

Thank you also to Alex Castaneda and Inga Zakauskas, whose dedication to refining, testing, and documenting the ORP fabrication process made it possible for us to confidently share this technique with others. They also hold the world record for the most ORPs produced, at least as of the writing of this guide.

Our sincere gratitude goes to Charles & Margery Barancik Foundation for believing in Oyster River Ecology's vision and providing the critical seed funding that transformed an ambitious idea into a functioning organization capable of making a real difference.

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Finally, thank you to the thousands of volunteers who have built and installed Oyster Rag Pots with Oyster River Ecology, and to the individual donors who keep our lights on and our trucks properly insured. Every ORP placed in the water represents not only restored habitat, but also the time, effort, and commitment of people who chose to become part of the solution.

This work belongs to all of you.

Contact Information

For questions about Oyster Rag Pots, ORP production, restoration applications, installation techniques, or opportunities to collaborate, please contact:

Damon Moore

damon@oysterriverecology.org

Or

Abbey Kuhn

abbey@oysterriverecology.org



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ORP Making Photography



Figure 1 – ORP making components with 2025 materials costs (CSA cement & bulk purchasing)

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Figure 2 – Placing rags into the cement mixer one at a time

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Figure 3 – Centering the rag to create the pot

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Figure 4 – A younger ORP maker volunteer hanging and ORP to dry

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Figure 5 – Wet ORPs on a drying rack

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Figure 6 – Chain to trees drying method for CSA cement at mobile volunteer events

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Figure 7 – Typical volunteer event making oyster rag pots



Figure 8 – Oyster Rag Pots in a 27-gallon tote, 15 ORPs per tote

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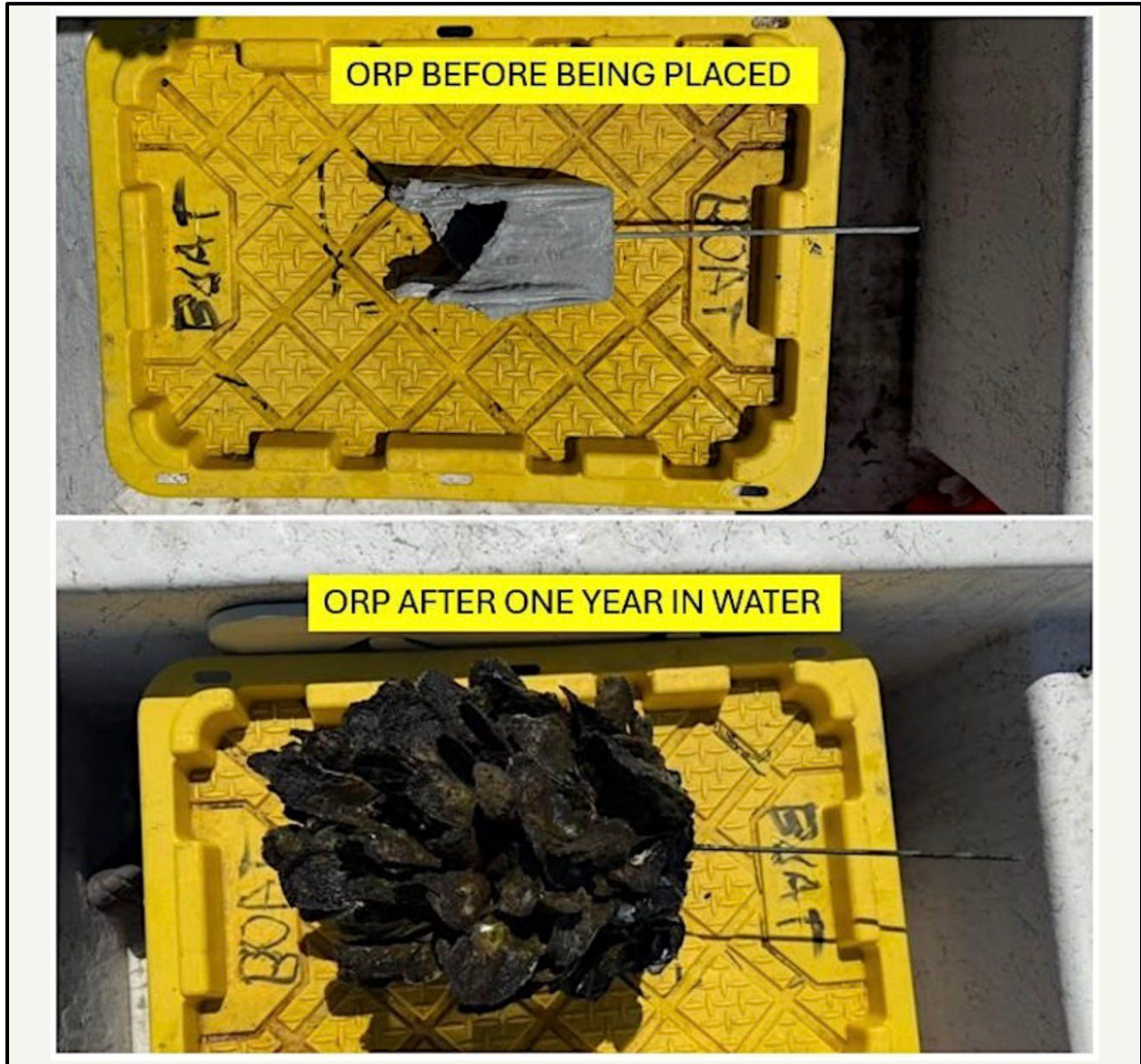


Figure 9 – Typical comparison between new ORP and ORP Installed in the Manatee River in May 2025 & Photographed April 2026