

What We Owe the Reef



Coral Reef Restoration in Costa Rica

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A coral reef gives more than it appears to.

Look closely and almost every opening holds something alive. Tiny fish disappear between branches of coral. Crabs tuck themselves into crevices. Eels wait beneath ledges while schools of fish gather above them. Juveniles find shelter here before moving into deeper water. Predators come to feed; other species come to reproduce. An entire community has been built around the architecture of coral. Although coral reefs occupy less than one percent of the ocean floor, roughly a quarter of marine species depend on them for some part of their lives.

Humans depend on them, too. Reefs feed families, support fisheries and tourism, soften the force of waves reaching coastlines, and provide livelihoods to people who may spend their lives beside—or beneath—the water.

For Pablo Piedra, one of Costa Rica's coral reefs did something more personal.

“The reef gave me everything. It gave me a life”.

Piedra spent sixteen years underwater as a divemaster on Costa Rica's southern Pacific coast before he began wondering what he owed the ocean in return. He returned to the same reefs year after year and watched them change beneath him. Coral formations he had known bleached, broke apart, or disappeared. Schools of fish grew smaller. Algae spread across places once crowded with living coral. Visitors could still descend into blue water and see beauty. Piedra could see what was missing.

“If you're taking something, it's your responsibility to maintain it,” he told me when we met in Uvita through [S.A.F.E. Worldwide](#), a wildlife and habitat conservation organization that helps support projects around the world.

Eventually, Piedra could no longer reconcile making a living from the ocean with simply watching it deteriorate. He began talking with friends and fellow divers about what they were seeing and, more importantly, what they could do about it. With funding and the help of others who shared his concern, they began building something unusual: a small laboratory devoted to learning how to keep vulnerable coral alive, grow it, study it, and eventually return it to the sea.

That effort became [Costa Rica Coral Restoration](#), a marine conservation project based at Marino Ballena National Park in Uvita, where Piedra is now co-founder and project leader.

The premise was simple. The reef had sustained him for years. Taking from it without giving something back no longer made sense.

Now he was going to try.

When the Ocean Changes: Coral Reef Restoration in a Warming Pacific

Inside Marino Ballena National Park, Costa Rica Coral Restoration operates a laboratory and education center devoted to something that would have sounded peculiar not so long ago: growing ocean coral on land. Laboratory Director James Jacob came to coral by a different route. Long before it became his profession, it was his hobby.

Jacob kept coral in home aquariums and discovered an informal culture of propagation among enthusiasts. If he visited a friend's house and admired a coral growing in the tank, the friend might break off a small piece and give it to him. Jacob would take the fragment home and grow it in his own aquarium. One coral became another. One tank led to more questions.

The same act that first fascinated him—taking a fragment of living coral and creating the conditions for it to grow—is now central to his work in coral reef restoration.

Only the stakes have changed.

Jacob's days move between science and the ordinary physical labor required to keep coral alive. He scrubs algae and marine growth from cages, checks pumps and water flow, monitors temperature and water quality, photographs and measures fragments, records changes in color and growth, and watches for disease or bleaching. He tracks which corals survive, which grow fastest, and which appear more resilient to heat and other stresses.

The team is also exploring the more difficult work of sexual reproduction, attempting to mimic the temperature, light, seasonal, and lunar cues that trigger coral spawning in the wild. If successful, eggs and sperm can produce genetically distinct offspring rather than clones of existing colonies—an important difference when the goal isn't simply to grow more coral, but to build reefs with enough genetic diversity to withstand an increasingly unpredictable ocean.

For Jacob, a fascination that began with a friend breaking off one small piece of coral has grown into a much larger question:

Can humans do more than replace the coral we've lost? Can we help build reefs resilient enough to survive the ocean that is coming?

Under ordinary circumstances, the restoration process has a destination:

Reef → fragment → laboratory → growth → acclimation → reef.

But that progression assumes something important. The coral eventually needs somewhere safe enough to return.

Coral Bleaching and El Niño: The Slow Death of a Reef

Increasing ocean temperatures and repeated marine heat stress are complicating that return. During the severe 2015–2016 El Niño, researchers documented major declines in live coral cover along Costa Rica's Pacific coast, including Marino Ballena. And coral bleaching is only part of the story.

There is no single villain. The reef absorbs pressure from nearly every direction: warming seas and ocean acidification, overfishing, coastal construction and weak environmental safeguards, agricultural runoff and sewage, pharmaceuticals and other chemicals carried downstream, and compounds found in some sunscreens. Each leaves a different fingerprint, and often several arrive at once.

For the coral, those distinctions don't matter. Stress accumulates. Eventually, a living coral begins to die.

Bleaching can look deceptively beautiful. Under heat stress, coral expels the microscopic algae living within its tissues, organisms that provide much of its energy and color. What remains can appear brilliantly, almost impossibly white. But white isn't renewal. It is a stress signal, the coral's skeleton suddenly visible through translucent tissue. If conditions improve, some coral can recover. If the stress persists, it can starve and die.

With a coral conservationist, even dinner conversation can turn to what has been lost.

Piedra remembers those losses accumulating over time. One catastrophic bleaching event can strip a reef quickly, but repeated smaller losses create another kind of emergency. A reef doesn't have to disappear in one dramatic moment. It can lose a little, then a little more, until there isn't enough left to recover. That is what makes the laboratory feel both hopeful and unsettling. Humans are taking coral from the environment where it evolved in an effort to keep it alive.

The ocean is where coral belongs.

Yet, for the moment, a tank can sometimes be safer.

Current bleaching conditions have forced Costa Rica Coral Restoration to suspend outplanting its laboratory-grown coral into the ocean. Instead, the team is concentrating on keeping coral alive in its tanks and preserving the genetic diversity of the local reef.

The restoration cycle has changed:

Reef → laboratory → growth → waiting.

And still, they persist. Inside the tanks, coral continues to grow. Around them, the people caring for it continue searching for what comes next.

Mimicking the Moon: Coral Spawning, Genetics, and Reef Restoration

For Jacob and the restoration team, keeping coral alive is only the beginning. They are also trying to help it reproduce. That means recreating pieces of the natural world inside an artificial one. Water chemistry can be controlled. Temperature and light can be adjusted. Even natural lunar cues can be mimicked as researchers explore coral spawning and sexual reproduction, with the possibility of producing genetically diverse offspring rather than relying solely on fragments of existing colonies. Fragmentation can multiply a successful genotype. Sexual reproduction creates new genetic combinations, producing the variation upon which adaptation depends. That shifts the question from how much coral can be grown to something far more consequential:

Which corals will be capable of living in the ocean that is coming?

The laboratory is therefore producing more than coral. It is producing knowledge: which individuals survive, which grow, which reproduce, which tolerate stress, and under what conditions. And that knowledge becomes more valuable when it travels.

Coral restoration projects around the world are confronting versions of the same problem with limited time and resources. What one laboratory learns about coral spawning, genetics, disease, heat tolerance, or survival can keep another from repeating years of trial and error. For CRCR, sharing methods and discoveries with other restoration projects is part of the work.

A breakthrough guarded inside one laboratory can only go so far.

The work is painstaking and expensive. Grants are scarce. Donations matter. Behind the tanks is the less visible machinery keeping a nonprofit marine conservation laboratory alive: proposals, volunteers, partnerships, donors, and people willing to keep showing up.

Perhaps that is another kind of reciprocity. A coral fragment is shared and grows into something more. Knowledge is shared and does the same.



Beyond the Laboratory: Protecting Costa Rica's Coral Reefs

For co-founder Laura Ruiz Madrigal, showing up is part of the answer.

After years in the private sector, she reached a point when giving something back felt possible—and necessary. As a Costa Rican, her attachment to the project is inseparable from her attachment to a country she describes with unmistakable pride. But she also sees inequalities in environmental education and the disconnect that can exist between people and the extraordinary ecosystems beside them.

Costa Rica is celebrated internationally for biodiversity and conservation. That reputation does not make its coral reefs invulnerable. Loving a place doesn't mean pretending it is protected.

It means accepting responsibility for what happens to it. And that responsibility extends beyond scientists. A laboratory can control water chemistry but not everything entering the sea. A restoration team can propagate coral but cannot regulate coastal construction, prevent pollution, or stop climate change. Restoring the reef therefore requires working with something considerably more difficult to control than coral.

People.



Growing Coral, Educating People: The Next Generation of Reef Conservationists

Education isn't an accessory to coral restoration at CRCR. It is part of the restoration strategy.

The organization's education center at the entrance to Marino Ballena National Park brings an ecosystem normally visible mainly to divers into view for schoolchildren, families, tourists, and local residents. CRCR also invites children and families from underserved communities, reaching young people who may grow up beside the Pacific without ever having the opportunity to descend beneath it. Here, the reef comes to them.

Sometimes the lesson begins with a fish they already know.

Nemo.

Using the familiar clownfish from *Finding Nemo*, educators can begin with something recognizable: Where does Nemo live? What is coral? Why do fish need coral reefs? What happens when coral dies?

A cartoon fish becomes an entry point into marine biology—and into something more important.

Agency: defined as personal choice and action. Free will. The power to change. A sense of agency begins with knowledge.

Climate change and coral bleaching are enormous concepts to hand to a child. CRCR brings some of that conversation down to the scale of everyday life: plastic, chemicals entering waterways, consumption, conservation, and choices made at home.

Sometimes the example is as ordinary as the font used to print a document. Choosing a typeface that requires less ink, or simply printing fewer pages, can reduce the ink, paper, energy, and other resources consumed by something most of us barely think about. One font will not save a reef. Neither will one plastic bottle.

That is not the point. Environmental responsibility isn't reserved for marine scientists, conservationists, or people with political power. It begins with understanding that ordinary choices have consequences and that those choices accumulate.

For young people, those choices can also start conversations. A font can lead to a question about paper. A plastic bottle can lead to a discussion about waste. Sunscreen can lead to questions about what washes from our bodies and eventually reaches the sea. Young people can ask those questions. They can talk to their families, influence the habits of adults, participate in local conservation, and speak up at school and in their communities.

Piedra and Ruiz Madrigal put the last part more simply: **Be loud**

That sense of agency matters, particularly for children growing up beside extraordinary biodiversity without always having equal access to the experiences, equipment, or education that make marine conservation feel like a world in which they belong. In the laboratory, Jacob and his team are asking how to grow coral capable of surviving the future. The education program raises a parallel question:

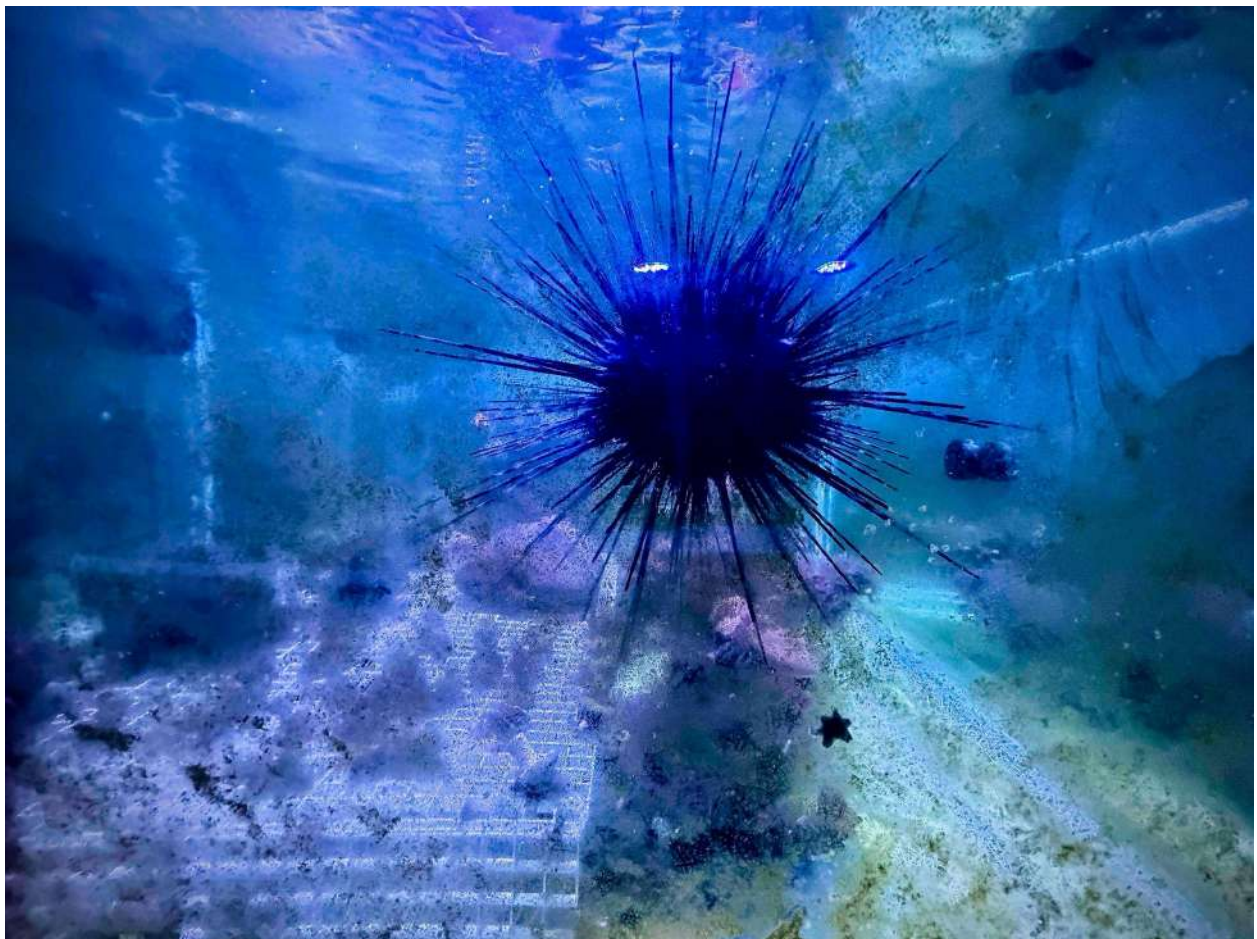
Can we grow the people who will care for those reefs, too?

Growing coral without changing the human behaviors and decisions contributing to its decline risks creating an endless cycle: restore what is damaged, return it, watch the pressures continue, and begin again. Education introduces another possibility.

One generation is trying to repair what has already been damaged.

The next is learning how to damage less.

That, too, is reciprocity.



Hope Isn't Required: Why Coral Conservation Continues

Near the end of our conversation, I asked Piedra about hope. “I have zero hope,” he said. Then he kept talking. The contradiction was more interesting than optimism.

Piedra has watched money and power repeatedly overwhelm environmental intentions. He doesn't believe people will necessarily change quickly enough simply because they understand the problem. But hope isn't why he does this.

He does it because he believes in the cause and in some of the people he reaches. Because the work makes him happy. Because after everything the reef gave him, doing nothing would mean walking away from a relationship that shaped his life. Perhaps coral conservation doesn't require believing everything will turn out well. Perhaps it requires deciding what is worth doing even when there is no guarantee that it will.

Returning Life to a Struggling Coral Reef

I arrived at Costa Rica Coral Restoration carrying one question:

What does it take to return life to a damaged reef?

I thought much of the answer lay in the science: fragmentation, cultivation, monitoring, acclimation, outplanting. Those things matter. But after sitting with Piedra, Ruiz Madrigal, and Jacob, the question felt bigger. Coral reef restoration requires understanding how coral grows, reproduces, and adapts. It requires laboratories, genetic diversity, scientific patience, money, and people willing to spend years learning how to mimic processes the ocean once accomplished without their help.

But the coral can be grown. However, the water still has to receive it.

That may be the uncomfortable boundary of restoration science. Humans can fragment coral, grow it, study it, and coax it toward reproduction. But returning it to the ocean without addressing what is happening to the ocean means returning it to many of the forces that damaged it in the first place.

Piedra spent years receiving something from the reef—a livelihood, beauty, experience, belonging—before deciding the relationship demanded something in return. Perhaps that is the larger story.

A reef itself is built on relationships: coral and algae, fish and habitat, sunlight and water, growth and decay. Our relationship with it is another one.

We take food and livelihoods from reefs. We build beside them. We swim above them and dive beneath them. We ask them to sustain fisheries, support tourism, protect coastlines, and remain beautiful while absorbing the consequences of a world changing above them. The reef keeps giving.

Reciprocity asks us to consider the other half of that relationship:

After everything reefs give us, what are we willing to give back?

About the Author

[Sherri Harvey](#) is a storyteller, educator, and explorer of both the digital and natural worlds. She teaches at San José State University, where she integrates sustainability and digital literacy into the learning experience. As a Fulbright Specialist and Adobe Vanguard, she approaches education as an adventure—one guided by curiosity, empathy, and connection.

At the core of her teaching philosophy is a belief in the transformative power of storytelling to challenge assumptions, foster empathy, and spark social change. Her classes are dynamic spaces where students examine how narratives shape perspectives and create meaningful connections. She currently teaches Global Studies 188, a course that takes San José State University students on a journey to Australia to explore the complexities of sustainability through hands-on, experiential learning.

As a storyteller, Harvey has created an award-winning documentary short recognized by the S.O.L.A. Film Festival, and her writing has been published in *Kelp Journal*, *Endangered Species Coalition*, *AAA Magazine*, and other outlets. Whether through film, writing, or immersive travel programs, she is dedicated to inspiring curiosity and empowering students to engage with global issues and make a real difference.

More about her work can be found at www.sherriharvey.com

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