[steps]

[music chime]

[music plays]

[NARRATOR:] Coral reefs are one of the most spectacular ecosystems found in nature. Hosts to numerous biological communities, they are important havens of biodiversity... and a valuable food source for over 500 million people. But as Earth's climate warms, so do the oceans, bringing heat stress to coral communities. When water temperatures get too warm, coral species may respond by expelling their symbiotic algae in a process called bleaching. Repeated or prolonged bleaching can lead to the death of entire coral colonies.

[music plays]

[NARRATOR:] Marine biologist Steve Palumbi is studying how different coral populations respond to heat stress caused by warming oceans. He regularly travels to Ofu, a tiny island in Samoa, for his field work.

[PALUMBI:] Ofu Island and the lagoon behind the reef here is one of the best coral laboratories in the world. These back-reef lagoons heat up to an extraordinary degree for a coral reef. They heat up to 32, 33, 34 degrees Centigrade. That's above the temperature at which most corals will bleach and die, yet these lagoons are full of thriving, growing corals of many, many species. So the question is, how do these corals do it? How do they live in such warm temperatures?

[NARRATOR:] To answer these questions, Palumbi and his colleagues conducted a controlled experiment, devising a way to apply heat stress to the corals in the lab.

[PALUMBI:] First we had to build a standardized stress tank so that we could expose corals from different parts of the reef to exactly the same stress.

[NARRATOR:] Palumbi took corals of the same species from two different parts of the reef, one living in a warmer pool of water, and the other in a cooler pool, and put them in the stress tanks. When grown and measured in these tanks, corals from the warmer pool were more resistant to bleaching. But could corals from the cooler pool become more heat-resistant if given time to acclimate to warmer temperatures? Another experiment was needed.

[music plays]

[PALUMBI:] So what's cool about corals is you can take them, break them into two fragments -- they're genetically identical clones of one another -- you can grow them in different environments and then retest them.

[NARRATOR:] Palumbi transplanted corals from the cooler Ofu pool into the warmer pool. He let them grow for three years, and then tested them again in the stress tanks. This time, the transplanted coral were more resistant to bleaching than their cooler ancestors... but still not as heat-resistant as the original warmer-pool corals. What makes the warmer-pool corals more resistant to heat stress? The answer is in their genes.

[PALUMBI:] The corals that are living in the warmer pool have better heat tolerance genes, and so they have a leg up on heat tolerance that the corals living in the cooler pool don't have. So as a consequence of five, six, seven years of work now, we have found that corals can change their heat tolerance and acquire higher heat resistance, but that having the right genes helps, too. A combination of acclimation and adaptation is what gives these Ofu corals such high heat resistance in the warmer pool.

[NARRATOR:] Could these scientific findings be applied to saving or repairing damaged coral reefs affected by heat and other stresses? To answer this question, Palumbi and graduate student Megan Morikawa have started another experiment.

[MORIKAWA:] This initial project, this reef restoration project, is really a big experiment. It's a big scientific experiment to see if different species transplant better than others, to see if different individuals within those species transplant better than others.

[PALUMBI:] Now the new spot in this case is across the mountain on the other side of the island at a... at a reef called sili. It was a beautiful reef 20 years ago. It got slammed by a hurricane. Corals there all rubble. Suppose we tried to restore that reef? And the experiment, which we've just started days ago, is to ask whether or not corals from the warmer part of the reef transplant and grow better than corals from the cooler part of the reef, and we'll monitor them over the next year to see who survives, who grows, and then who grows best of all.

[MORIKAWA:] So I've made it a goal of my career to try and bridge the gap between research sciences and real-world application. And this is a project that is attempting to do just that. We're trying to bring a good project to a place that has special coral; that has the management agencies in place in order to understand the importance of the research that we're doing. So it's a very fortunate dissertation project to work on. I consider myself lucky every day.

[music plays]

[PALUMBI:] So one of the most important things that corals have going for them actually is that people around the world care about them. They recognize the productivity of reefs, and the importance of them to the people that live there... the way they protect shorelines from erosion... their beauty. And that kind of attention, like attention on tropical rainforests, results in people asking, well, what can we do to save these amazing ecosystems? That's a really important first step, because with that kind of willpower and the attention of the world on the problem, then maybe we have a chance of fixing it.

[music plays]