Tempest news

MENU

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TEMPEST NEWS | JULY 2022

Andrea Grottoli, co-author of "Coral-bleaching responses to climate change across biological scales" and professor of Earth Sciences at OSU.

Warming temperatures in the Earth's ocean are causing many marine animals, including coral, to disappear. In fact, about 75% of all coral reefs have already experienced bleaching. **A new study** into mitigating the effects climate change has on these organisms indicates that more international collaboration is needed to preserve the future of more than 6000 coral species.

Today, we sat down with Andrea Grottoli, co-author of the study and a professor of Earth Sciences at Ohio State University to talk about coral bleaching, reef conservation, and climate change. **Watch the interview on YouTube >>>**

Q: HOW DID YOU GET STARTED WITH EARTH SCIENCES, NAMELY REEF CONSERVATION?

A: As a kid growing up, I was always around lakes and rivers, and always wanted to do something that involved aquatic environments. When I went to graduate school, I thought it was a good idea to get some expertise in a marine environment, so I'd have skills in both freshwater and marine. I never went back to the freshwater! I ended up doing my Ph.D. in marine science. I wanted to do something that would help make the planet a better place to help with environmental issues, and studying coral bleaching and the effects of climate change on corals is part of that personal interest.

Q: CAN YOU EXPLAIN WHAT CORAL BLEACHING IS?

A: Corals are symbiotic organisms, they're an animal. They also have inside them algal cells, and together they form a symbiosis. The algae provide photosynthetic sugars...just like plants photosynthesize, these algae photosynthesize and supply the coral host with sugars, which can provide up to 100% of their food needs in a day.

But the animal part also eats zooplankton and other particles, which are really nutrient-rich together. These two ways of getting food are what allow a coral to live in the environment that it does. That symbiosis is key to the survival of corals.

When seawater temperatures increased by as little as one to two degrees Celsius, for as little as 10 days in a row, above the normal summertime maximum, corals start to get stressed. And one of the consequences of that stress is they release their endosymbiotic algae. We see through the clear gelatinous tissue of the animal hosts to the white skeleton underneath - hence the term bleaching. When corals are bleached, they're in a starvation state because they're no longer getting those photosynthetic sugars. And if the heat stress event lasts long enough, the corals start dying. And that's where the real risk from bleaching events comes in.

Q: HOW MANY PEOPLE ARE INVOLVED IN THE OBSERVATION AND REPORTING BACK OF THE CONDITION OF ALL THESE VARIOUS REEFS?

A: When a bleaching event is happening, there are several ways that data is collected. It's scuba divers on reefs that have specific places that they're observing, and they're going back regularly and recording. On large scales, like the Great Barrier Reef, they actually use planes that fly low over the reef, and they photograph as they go. Then they quantify the amount of whiteness in the shallowest part of the reef because you can't see very deep, but that's another way to get large-scale surveys. The other tool that's used is satellite measurement of sea surface temperature. And there are really well-developed algorithms for converting or for interpreting sea surface temperature. Knowing when we're going into a potential heat stress event or a bleaching event and can predict that now based on how many days it's been above a certain temperature in certain regions, and NOAA has a website called **Coral Reef Watch** that gives predictions for where we expect to see bleaching, and when it hits a certain point where there shouldn't be bleaching. Then there are oftentimes people on the ground that are going and verifying or calibrating and ground-truthing effect that there is bleaching, and you'll have people reporting in those bleaching events.

Q: THERE ARE VARIOUS PROTECTIONS IN PLACE FOR ENDANGERED SPECIES. FOR CORAL REEFS, ARE THERE ANY AUTOMATIC PROTECTIONS IN PLACE WHERE YOU CAN SEE THAT A REEF IS EXPERIENCING BLEACHING, AND TAKE ACTION ACCORDINGLY?

A: Not especially. There are reefs that are a part of marine protected areas or marine parks. And the degree of protection in those marine protected areas or parks varies depending on where you are in the world. It can range from no research allowed and nobody is allowed to go there, to limited taking or limited research or research only in certain ways. And so that varies, and it's the way marine environments are protected. Unlike the Endangered Species Act, which can be invoked to protect huge swaths of terrestrial environments. To my knowledge, that strategy has not been used to protect marine species. But there certainly are examples of species in the Caribbean in the fleur reef track that would qualify for that kind of response, should the Endangered Species Act to be used in that way.

Q: CAN YOU EXPLAIN THE IDEA BEHIND A REEF SANCTUARY?

A: A reef sanctuary is sort of an expanded version of marine protected areas. Mari protected areas are typically within a country's waters or within international wat that are within their boundaries. Whereas these mesoscale marine sanctuaries, yours that we're talking about in the paper, are ones that would be designed based on where the need is, irrespective of geographical boundaries. And different countries would collaborate in order to create these much larger, protected areas under this sanctuary structure.

Q: DO VARIOUS COUNTRIES ALREADY SOMEWHAT COLLABORATE WHERE THAT'S CONCERNED? OR WOULD THIS BE SORT OF A NEW VENTURE?

A: It has happened in the terrestrial environment, but it has not happened in the marine environment. But there are precedents for it in the terrestrial environment, and so there's no reason why the same approach couldn't be done in a marine environment. Coral reefs are often in countries that are often struggling financially. The majority of coral reefs are in developing and underdeveloped countries. And so structuring any kind of sanctuary requires financial commitments by the countries that can afford to do so in order to facilitate the sanctuary structure and management.

Q: THERE ARE SEVERAL STUDIES SUGGESTING THAT THE ONLY SUSTAINABLE REEF CONSERVATION IS JUST MITIGATING GLOBAL CLIMATE CHANGE. ARE THESE MESOSCALE SANCTUARIES A MORE MANAGEABLE AND IMMEDIATE SOLUTION WHILE POLITICIANS FIGHT OVER MEASURES TO MITIGATE CLIMATE CHANGE?

A: Mitigating climate change is non-negotiable. That has to happen. But even if we were to implement the strictest climate mitigating processes, and we put that into effect right now, we would still warm for a little while. There's a lag effect in the atmosphere, in how greenhouse gases are processed, and when the planet would actually start cooling. So even with the strictest climate change scenario, we would need to have additional measures locally on the ground to help corals survive the intervening decade or few decades until the climate is mitigated and temperatures start to come down. So it is not a question of one or the other, it's both simultaneously since we haven't started really effectively mitigating climate change yet. It puts even more pressure on local things that we can do for conservation, restoration, and management in order to optimize the chances that enough coral reef survives the coming decades. That way, by the time climate change does start coming down, and we start cooling, there will be enough reef ecosystem that's

functioning left to repopulate and refill where we've lost reef because we will lose reef - we are losing reef. It's a question of how much and how fast.

Q: IT WAS NOTED IN YOUR STUDY THAT THERE MAY BE CORAL REEF POPULATIONS ABLE TO EVOLVE IN THESE WARMING WATERS. IS THAT SOMETHING THAT HAS BEEN DOCUMENTED OR SOMETHING THAT IS MORE OF A HYPOTHESIS BASED ON RESEARCH?

A: Experimentally, we've been able to show that some corals are able to acclimatize to shifts in their baseline temperature and acidity conditions, because simultaneous with ocean warming is ocean acidification. They're both effects of increasing atmospheric CO2. We have a paper that came out recently showing that coral exposed to shifts in their baseline temperature and pH for almost two years, about half will survive, and they seem to be doing well. And so they're acclimating, which means there's some evidence for innate genetic capacity for resilience. But we have to remember half died. So even if there's some resilience, it's not all species, and it's not everywhere.

There's a population of coral in the northern part of the Red Sea that's never been observed to bleach, even though it gets super hot. And so there are these tiny little pockets of refugia coupled with the capacity that some corals may be able to acclimate. That gives us hope that we will have corals over the coming decades. But it should not change the fact that at least half are going to probably die. And it doesn't give us any more wiggle room in saying, well, we don't really need to mitigate climate change. It's not that at all, it's just giving us some measure of hope that we can, and that restoration efforts could be successful. That we could identify resilience, we could do successful reservation, we could do targeted, large-scale conservation areas, and sanctuaries that are strategically placed that encapsulate potentially more resilient environments or species. So we could be smart about it. But that's just a way of dealing with a really crummy hand.

Q: WHAT DO YOU SAY TO PEOPLE WHO ARE NOT NEAR AN OCEAN, WHO MIGHT BE HEARING THIS NEWS AND WONDERING "WHY SHOULD I CARE? HOW DOES THIS AFFECT ME?"

A: Coral reefs provide essential goods and services to people all over the world. In the tropical zones, food, stability of coastlines, protection from storms, sand to beaches, tourism revenue, etc. - The economic value of coral reefs globally is almost $10 trillion a year. So it's a non-trivial economic driver. And if all you care about are dollars and cents, that economic piece alone would be enough to say, "Okay, reefs are important because they have a huge global economic importance." And if those

reefs fail, and those people now have no income, and no stability, now you have mass migration coupled with sea-level rise and global warming, you have mass migration. So it has the potential to really destabilize our global economy and structure. I'm particularly fond of coral reefs, but we can tell the exact same story about the Arctic, and rain forests. So many other ecosystems are affected by climate change. So even if coral reefs don't speak to you, but another ecosystem does, they are all affected by climate change in our entire global ecosystem balance depends on mitigating climate change, treating our environment better - being better hosts of our planet.

Tempest innovators

Struggling not to get distracted by smartphone notifications when checking the subway schedule from his New York apartment, Rohan Singh had a lightbulb moment: A dedicated subway sign in his home. He soon got to work developing a prototype for what would become the **Tidbyt** LED matrix display. After recruiting co-founder Mats Linander and Software Engineer Mark Spicer to the venture, the company ran a successful Kickstarter campaign in 2021 and is now selling its sleek retro display on its website.

The Tidbyt app is straightforward and simple to use, with pre-built applets even users without coding experience can master. Since opening up their platform for external developers to build their own custom apps and integrations, the possibilities for what kind of data to display extend far beyond subway schedules.

"Whether you're interested in the NFL or the MLB, Tempest, pinball, Duolingo or Strava, Tidbyt probably has an app for it," said Mark Spicer, Tidbyt's Founding Software Engineer. "If not, we have a community eager to write new apps for the platform." **>>> Shop Tidbyt**

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AI CAN HELP DETERMINE CORAL REEF HEALTH BY SOUND

Coral reefs often bring to mind vibrant, colorful images of abstract points and shapes with schools of fish and other sea life bustling throughout. It's also commonly known that as seawater temperatures continue to rise, reefs are beginning to die out in a process known as coral bleaching. Losing their bright colors is one way to tell if a reef is in distress, but researchers in the United Kingdom are using machine-learning techniques to gauge a reef's health by using an unexpected medium: sound.

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WARMING SEA WATERS ON THE MENU

There are many reports suggesting that the Earth's warming climate is already beginning to affect us in our day-to-day lives. One team of researchers from the

University of British Columbia took on a new angle when studying the manifestati of warmer living in their quest to better understand how warming ocean waters ar affecting the types of seafood that we eat. They didn't get their data out by measuring temps in the field or taking aquatic samples, but by staying on dry land and sifting through 100s of restaurant menus dating as far back as the 1880s.

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EXTREME WEATHER HAS REACHED NATIONAL PARKS

From the Yellowstone flood to extreme heat and dying tree diversity in Yosemite, it is becoming clear to scientists, park officials and employees, parkgoers, and beyond that the consequences of a warming climate are reaching our national parks. At its current pace, Yosemite could see an average temperature increase of up to 12 degrees Celsius by the end of the century but reports from park rangers and other research suggest that warming effects are already beginning to arrive. Increased wildfire activity, drying up waterfalls and shrinking snowpack, and increased tree die-off is being seen across parks and is expected to continue.

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